CHAPTER 3

CRANE CREW SUPERVISOR

In minutes, a crane can easily lift and place a load weighing several tons. Major tasks involved in any construction or ship-loading operation are the handling of supplies, the driving of piles, and the excavation of materials. Most of these tasks are performed by equipment belonging to the lifting and loading family. Part of this family are cranes with various attachments, such as hook block, clamshell, dragline, and pile driver. Cranes provide safe and efficient accomplishment of assigned tasks when operators use them properly and demonstrate the same respect for the crane as they should any other labor-saving device; however, the first time you bend the rules or take shortcuts, disaster is waiting to happen.

As a direct result of OPERATOR ERROR, crane accidents take heavy and tragic tolls each year. People are crippled or killed and enormous property damage is incurred as a direct result of crane accidents. Nine out of ten crane accidents that occurred in the past could have been avoided. Over eighty percent of these accidents were due to operator inattention, poor judgment, overconfidence, or excessive speed.

The Naval Construction Force (NCF) has for many years recognized the requirement for an extensive crane safety program. The crane safety program applies to crane operators and the safe operation of weight-handling equipment. Standards for weight-handling equipment operations are outlined in the *Management of Weight-Handling Equipment,* NAVFAC P-307; *NCF Equipment Management Manual,* NAVFAC P-404; NMCB *Equipment Management,* COMSECOND/COMTHIRDNCBINST 11200.1 series; *Use of Wire Rope Slings and Rigging Hardware in the NCF,* COMSECOND/COMTHIRDNCBINST 11200.11; and *Testing and Licensing of Construction Equipment Operators,* NAVFAC P-306.

CRANE CREW SUPERVISOR RESPONSIBILITIES

The Naval Construction Force crane crew supervisor is assigned and designated in writing by the commanding officer. The person selected is normally the best crane operator available within battalion-wide assets. The equipment officer, crane test director, and the crane crew supervisor share the responsibility of ensuring that any crew that prepares, assembles, operates, or works with or around cranes are well trained in both safety and operating procedures.

CRANE CREW

The equipment officer and the Alfa company operations chief should select the crane crew at the beginning of the home-port period. Construction tasking requiring crane support and the number of cranes assigned in the TAB A dictate the size of the crane crew.

During the home-port period the crane crew supervisor should be aware of and review all construction tasking that requires crane support. A knowledge of crane operations enhances your ability to make proper plans to meet construction tasking. Proper planning means you select the correct number and types of crane lifts, assign the correct type of crane needed to accomplish the task, select the correct rigging gear, and assign a competent crew to perform the lift. Additionally, if any special skills are required to perform any of the tasking, you should know that special training can be coordinated through your battalion training department with the Naval Construction Training Center (NCTC), Port Hueneme, California, or Gulfport, Mississippi.

Qualifications

The skills and safety standards demanded for efficient crane operations require only mature professionals be assigned as crane operators and riggers on a crane crew. Equipment Operators must meet the minimum physical examination requirements as established by the NAVFAC P-306. Additionally, they must pass a written and operational skills test.

Crane License Program

Before receiving a license to operate a crane, crane operators are required to attend 40 hours of formal classroom instruction on crane operating safety, as outlined in the NAVFAC P-306. The Naval Construction Training Centers (NCTC), Port Hueneme, California, and Gulfport, Mississippi, offer a crane school that covers the requirements of the NAVFAC P-306. Additionally, operators who need to renew their license and have completed the 40 hours of crane safety must attend a minimum 8-hour refresher training course on crane operator safety.

The testing of crane operators is the direct responsibility of the crane certifying officer and cannot be delegated. The crane certifying officer may be assisted in administering a performance test by the crane test director. Performance tests are conducted, as outlined in the NAVFAC P-306. The crane manufacturer's manual is used to test the operator on the operator's maintenance responsibility.

The equipment officer is normally responsible for the duties of the battalion crane certifying officer. As outlined in the NAVFAC P-307, the crane certifying officer must be designated in writing by the commanding officer of the activity. The crane certifying officer designates in writing the crane test director.

A crane license is issued on the Construction Equipment Operator License, NAVFAC 11260/2, and will indicate the make, model, capacity, and the attachments the operator is qualified to operate. Operators requiring more on-the-job training with cranes can be issued a training license for a periof of 30 days. The trainee must be under the supervision of a qualified crane operator. The training license must denote the make, model, capacity, and the attachment on which the operator is to be trained.

Before you deploy, ensure that the crane crew has several licensed crane operators. Your licensed operators will be needed to support the Battalion Equipment Evaluation Program (BEEP) of the cranes. The crane certifying officer designates in writing the crane test operator and the crane test mechanic. These positions are required for the crane certification program. The crane certifying officers may also designate an alternate crane test director, test operator, and test maintenance backups.

BEEP

Cranes are normally condition inspected, load tested, and certified annually, as prescribed in the NAVFAC P-307; however, in the NCF, lest procedures for cranes are performed during the BEEP as a joint battalion effort. Time management is important when performing the BEEP of the crane area of responsibility. You must remember that the weight testing of cranes is a time-consuming event and should be completed before (he end of the BEEP.

The BEEP Equipment and Attachment Evaluation Inspection Guides for cranes are issued by the dispatchers. The inspections of the cranes are performed jointly by the EOs assigned to the crane crews. Once the EOs have completed the Equipment and Attachment Evaluation Inspection and the paper work is taken to the dispatcher, the crane mechanics will jointly inspect the crane, using the inspection guides. The crane mechanics also have the responsibility of performing the Crane Condition Inspection which is documented on the Crane Condition Inspection Record (figs. 3-1A and 3-1B). This inspection, commonly known as the “before, during, and after inspection,” is part of the crane weight-testing procedure and can be performed at the same time the mechanics are performing the equipment and attachment inspection. The crane test director is also responsible for inspecting and reviewing the items on the Crane Condition Inspection Record.

After the crane is released from the shop, the crane crew supervisors have the responsibility to prepare the crane for the weight-testing procedure. Accomplishing the weight test for certification of the crane is important, because the ERO for the crane cannot be closed out until the crane is certified.

The weight testing of cranes requires the use of big, heavy weights, a stable foundation, and an area clear of obstructions. Some deployment sites have an area in Alfa company with weights for the weight testing of cranes; however, Public Works Centers overseas normally has an area allocated for the weight testing of cranes. They normally allow the battalions to schedule time periods for use of this area.

When a crane has to be transported to the weight-testing-area, the crane crew supervisors must receive the planned travel route to determine if low wires, low overpasses, narrow bridges, or unsafe obstacles exist. The absolute limit of approach for

CRANE CONDITION INSPECTION RECORD

Crane No.	Type	Location	Operator names	Operator License Nos.
82-00001	Truck Crane	Pier 4	John A. Doe	3-1000H

Purpose of inspection:	Date started	Date completed
TYPE C INSPECTION	5-24-92	5-26-92

Item No.	Item description	B	D	A	Insp/ Init.
1	Bent, cracked, or corroded structural members	S	S	S	LS
2	Cracked or corroded welds	S	S	S	LS
3	Loose, broken, missing, or deteriorated rivets or bolts	S	S	S	LS
4	Inspect all wire rope for wear, broken wires, corrosion, kinks, damaged strands, crushed or flattened sections, condition of sockets, and dead end connections. Check for proper lubrication and evidence of proper inspection of idler sheaves and saddles. See Appendices C and D for detailed inspection requirements and rejection criteria.	S	S	S	LS
5	Inspect hooks for cracks, sharp edges, and distortion. Verify disassembly, inspection, and nondestructive test (NDT) as applicable. See paragraph 1.4 of Appendix E for detailed requirements.	S	S	S	LS
6	Inspect all brakes and clutches for proper operation. Spot check components for proper adjustment and acceptable wear.	S	S	S	LS
7	Check all controls for proper condition and operation	S	S	S	LS
8	Check all control components for proper condition and operation	S	S	S	LS
9	Inspect all limit switches for condition and proper operation	S	S	S	LS
10	Ensure each drum has minimum of two complete wraps of wire rope at lowest working level	S	S	S	LS
11	Check load indicators for condition and working accuracy	S	S	S	LS
12	Inspect all mechanical equipment which is reasonably accessible for wear, cracks, and alignment	S	S	S	LS
13	Inspect where practical for worn, defective, or misaligned bearings, bushings, shafts, pins, and gears.	S	S	S	LS
14	Check components for excessive heat, vibration, noise, and oil leaks	S	S	S	LS
15	Inspect sheaves for wear, roughness, free-turning, and alignment. Gauge sheave groove where possible.	S	S	S	LS
16	Inspect for excessive wear of wheels, tires, rollers and roller paths or rails	S	S	S	LS

Figure 3-1A.—Crane Condition Inspection Record (Front).

Item No.	Item Description	B	D	A	Insp/ Init.
17	Inspect for excessive wear of chains and sprockets. Measure chain stretch of load chains.	S	S	S	LS
18	Verify that correct certified capacity charts or hook load rating data is in view of operator and/or rigging personnel	S	S	S	LS
19	Inspect operators cab for cleanliness and operation of all equipment	S	S	S	LS
20	Check machinery house for cleanliness, proper safety guards, warning signs, and storage of tools and equipment	S	S	S	LS
21	Check operation of all indicators, warning devices, and lights	S	S	S	LS
22	Check for proper type and condition of all fire protection equipment	S	S	S	LS
23	Verify that pressure vessel inspection certificates are posted and current (see NAVFAC MO-324 or appropriate document for test procedures)	S	S	S	LS
24	Check condition and function of outriggers, pads, boxes, wedges, and cylinder mountings. Check level indicators	S	S	S	LS
25	Check center pin nut and steadiment by observing operational behavior during load test (see paragraph 2.2.2, Appendix E)	N A	N A	N A	LS
26	Check travel, steering, braking, and locking devices for condition and proper operation	S	S	S	LS
27	Check radius indicator for accuracy by measuring actual radius in at least two boom positions	S	S	S	LS
28	Check pawls, ratchets, and spuds for proper engagement and operation of interlocks	S	S	S	LS
29	Inspect tanks, lines, valves, drains, filters, and other components of air systems for leakage and proper operation	S	S	S	LS
30	Inspect reservoirs, pumps, motors, valves, lines cylinders, and other components of hydraulic systems for leakage and proper operation	S	S	S	LS
31	Check engines and engine-generator sets for proper performance, safety and system leakage	S	S	S	LS
32	Inspect for bent, cracked, corroded, or dented boom members	S	S	S	LS
33	Check condition of counterweights, ballast, and securing fasteners	S	S	S	LS
34	Check all compartments (voids) for water tightness	NA	NA	NA	LS
35	Check accuracy of list and trim indicators against design data or previous test data	NA	NA	NA	LS

Remarks:

NA

Legend: B--before; D--during; A--after

Jack R. Frost CM-1 Inspector Signature/Date 5-26-92	Walter T. Dorn EOC 5-26-92 Test Director Signature/Date

Figure 3-1B.—Crane Condition Inspection Record (Back).

power lines must be the following: 0 to 125,000 volts, 10 feet; 125,000 to 250,000 volts, 15 feet; over 250,000 volts, 25 feet. Anytime you are traveling with a crane, stay a minimum of 4 feet from any electrical power source. You must inspect the crane test pad area, slings and rigging gear, and obtain travel permits if required. This review is documented on the Crane Lift Checklist (fig. 3-2) outlined in the

CRANE LIFT CHECKLIST

Date ____________________

1. Location of lift: ____________________

2. Supervisor responsible for lift: ____________________

3. Crane operator: ____________________

4. Rigger(s)/helper(s): ____________________

5. Lift: ____________________

   a. Description of lift:

   b. Weight of item to be lifted: ____________________

   c. Was weight estimated: Yes: ____ No: ____ If yes, by whom: ____________________
      Can weight be verified? Yes: ____ No: ____ If no, contact the crane certifying officer for further instructions.

6. Crane assigned to lift:

   a. USN #: ____________

   b. Capacity: ____________

7. Is travel route free of unsafe obstacles: Yes: ____ No: ____
   If no, explain:

8. Have travel permits been obtained (if required)?
   Yes: ____ No: ____ N/A: ____

9. Have operators and riggers been briefed on sequence to be followed during lift?
   Yes: ____ No: ____ If no, explain:

10. Has crane setup been inspected for stability?
    Yes: ____ No: ____ If no, explain:

11. Has crane operating area been inspected?
    Yes: ____ No: ____ If no, explain:

12. Have slings and other hardware being used been inspected?
    Yes: ____ No: ____ If no, explain:

Figure 3-2.-Crane Lift Checklist.

Crane No.	Type	Location or Assignment	Shift 1 2 3	Date

Hour Meter Readings Beginning	Ending	Hrs Operated This Shift	Operator (Name) Oiler (Name)
			Legend: "S" Satisfactory, "U" Unsatisfactory

Item	S	U	Item	S	U	Item	S	U
Engines-Oil Levels			Walkways, Ladders, Handrails			Radiator Coolant		
Fan Belts			Glass			Tanks (Oil-Air)		
Fuel Oil (Amount)			Hooks			Air Compressor		
Gauges & Indicator Lights			Housekeeping			Battery-Water		
Wire Rope & Reeving			Lubrication			Tires & Wheels		
Limit Switches			Wind Locks & Chocks & Stops					
Brakes			Controllers					
Leaks (Fuel-Oil-Water)			Motors					
Warning Devices			Lights					
Instructions: See reverse side						Fuel Gals	Oil Qts. Gal	

CRANE OPERATOR'S DAILY CHECKLIST

(FRONT)

Instructions	
Check all items daily. Suspend operations immediately if an unsatisfactory item effects safety for continued operations and report all such conditions immediately to the supervisor-in-charge.	Report unsatisfactory items not effecting safe operations to the supervisor-in-charge at the end of the work shift.

Remarks (Unsatisfactory Items)		
Operator Signature	Operations Supervisor Signature	Date
Remarks:		Supplies (Check if required)
Maintenance Supervisor Signature	Date	

(BACK)

Figure3-3.—Sample of the Crane Operator's Daily Checklist.

COMSECOND/COMTHIRDNCBINST 11200.1 series.

The Crane Lift Checklist must be filled out by the crane crew supervisor or the crane test director before the crane can proceed to any project or make any crane lifts. After the Crane Lift Checklist is completed, make sure you brief the operators and riggers on specifics of the lift and travel conditions.

Crane Operator's Daily Inspection

Before a crane is operated or transported, it must be thoroughly inspected by the operator. The operator uses the Crane Operator's Daily Checklist (ODCL) (fig. 3-3). The operator visually inspects and checks each item prescribed on the checklist.

When the operator observes a deficiency of a load-bearing or load-controlling part or safety device (major deficiency) or an operating condition that would cause the slightest loss of control or otherwise render the crane unsafe, the operator must secure the crane and notify the crane crew supervisor. The crane crew supervisor informs the chain of command of any crane problems.

The NAVFAC Form 11260/4 is additionally used with the ODCL when dispatching the crane. The ODCL is turned into the crane crew supervisor at the end of each day or shift for review and signing. As outlined in the NAVFAC P-307, the minimum requirement for retaining the ODCLs is the ODCLs for the previous month of operation and the ODCLs of the current month of operation.

Wire Rope Inspection

Part of the ODCL inspection is the thorough inspection of all wire rope before using a crane. All running ropes in continuous service must be visually inspected for crushing, kinks, corrosion or other damage, broken wires, and proper lubrication (fig. 3-4). Other areas to inspect are the following:

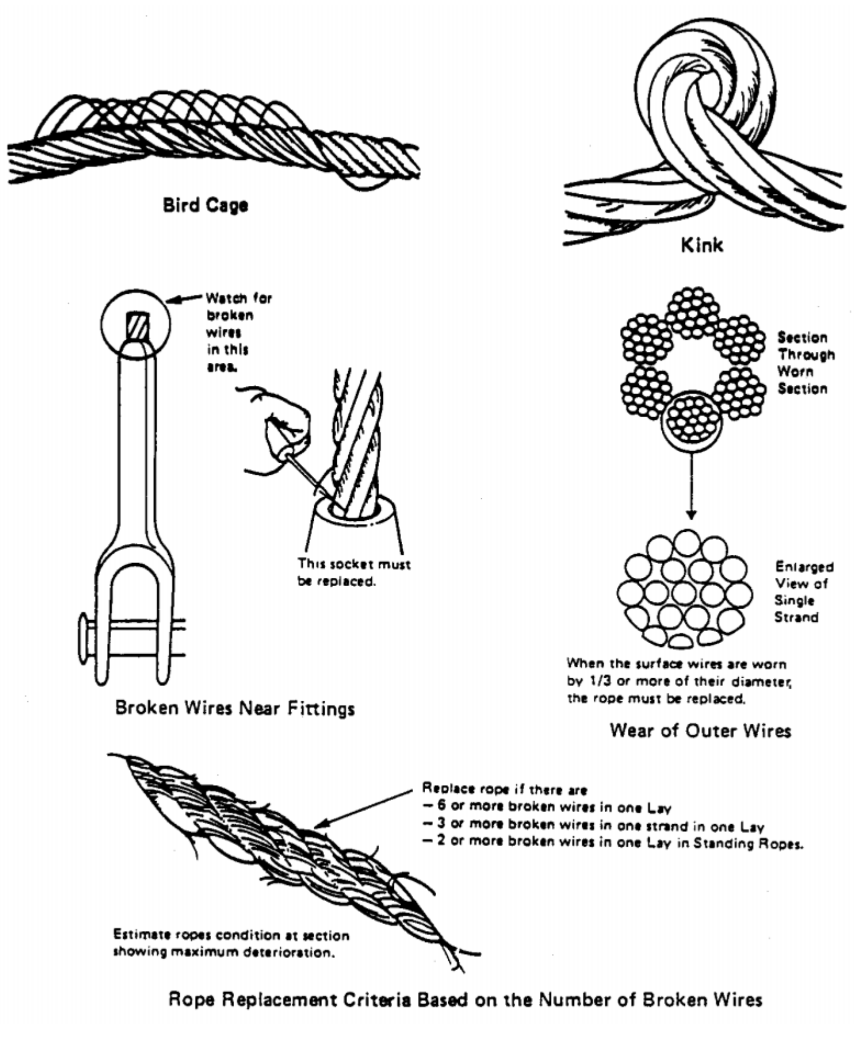


Figure 3-4.—Common wire rope defects.

wire rope sockets, swagec fittings, swivels, pendants, and securing hardware for wear. Winch ecnd fittings need only bebc disconnected or disassembled when experience or visible indications deem it necessary. The exact time for replacement of the rope cannot be given because many variables are involved; however, safety depends upon the use of good judgment in evaluating wire rope. The following conditions are reasons for wire rope replacement:

Running ropes—Six or more broken wires randomly distributed, broken or torn wires in one lay, or three broken wires in one strand in one lay. Replace end connections when there are any broken wires adjacent to the end connection.

Boom pendant ropes—More than two broken wires in one lay in sections beyond the end connection or one or more broken wires at an end connection.

Kinks or crushed sections—Severe kinks or crushed rope in straight runs where the wire rope core is forced through the outer strands.

Flatened sections—Flat sections where the diameter across the flat section is less than five sixths of the original diameter.

Wire rope wear—Measure wire rope with wire rope calipers (fig. 3-5) to check for wear accurately. Replace wire rope that has wear of one third of the original diameter of outside individual wires. A crescent wrench can be used as an expedient means to measure wire rope.

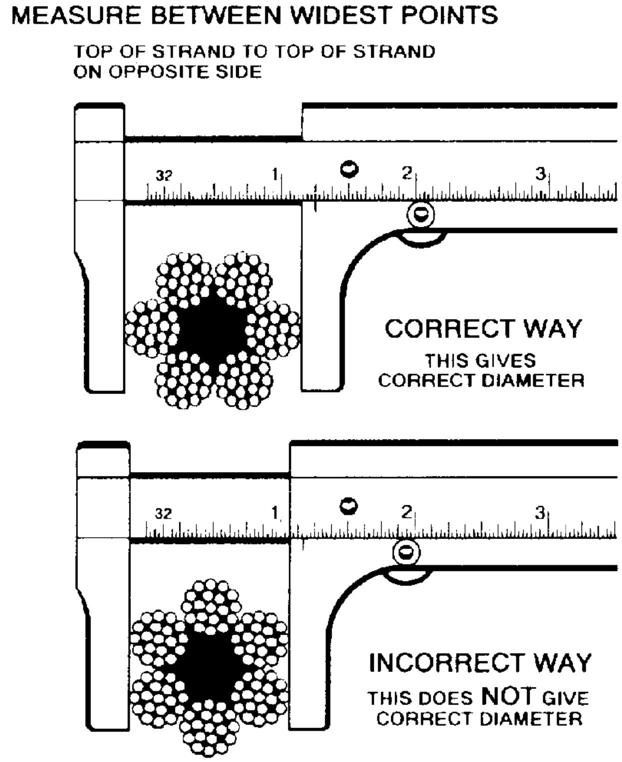


Figure 3-5.—Measuring wire rope.

Wire Rope End Connections

Wire rope end connections must be as specified by the manufacturer. If wedge sockets are used, they develop only 70 percent of the breaking strength of the wire rope due to the crushing action of the wedge. Exercise caution when wedged socket connections are used to make rated capacity lifts. Wedge sockets are particularly subject to wear, faulty component fit, and damage from frequent change outs, and are highly vulnerable to inadvertent wedge release, and disassembly in a two-blocking situation. Wire rope clips that clamp both the dead end and live rope must not be used with a wedge socket (fig. 3-6).

Such connectors are hazardous because they restrain the wedge from seating properly in the socket. Wedge sockets must be installed as specified in the following procedures:

1. Cut and remove any section of wire rope that was used in a socket and was subject to sharp bending and crushing before resocketing.

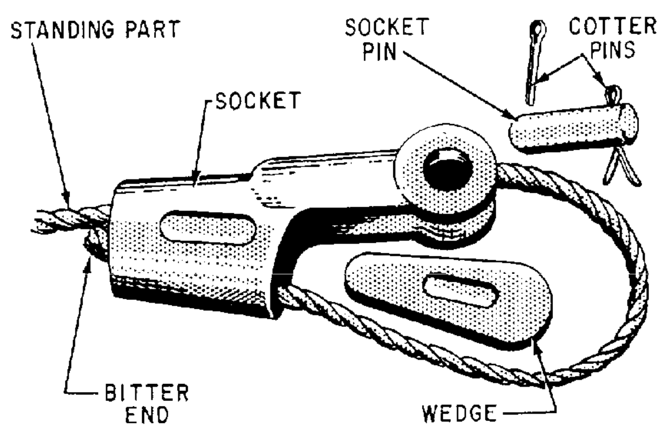


Figure 3-6.—Wedge socket.

2. Install the wedge socket carefully to ensure the wire rope carrying the load is in direct alignment with the eye of the socket clevis pin so the load pull is direct.

3. Place the socket upright and bring the rope around in a large, easy-to-handle hoop. Extend the dead end of the wire rope from the socket for a distance of a least one rope lay length. Insert the wedge in the socket, permitting the rope to adjust around the wedge.

4. As a safety precaution, install a wire rope clamp on the dead end of the wire rope that comes out of the wedge socket (fig. 3-7). Measure the distance from the base of the wedge socket to the clamp. This measurement is used as a guide to check if the wire rope is slipping in the wedge socket

5. Secure the socket to a support and carefully take a strain on the live side of the rope to ensure the proper initial seating of the wedge. Increase the load gradually until the wedge is fully seated. Avoid applying sudden shock loads.

Hook Block Inspection

The hook block and the hook is part of the ODCL inspection. The operator must inspect the hook block for cleanliness, binding sheaves, damaged or worn

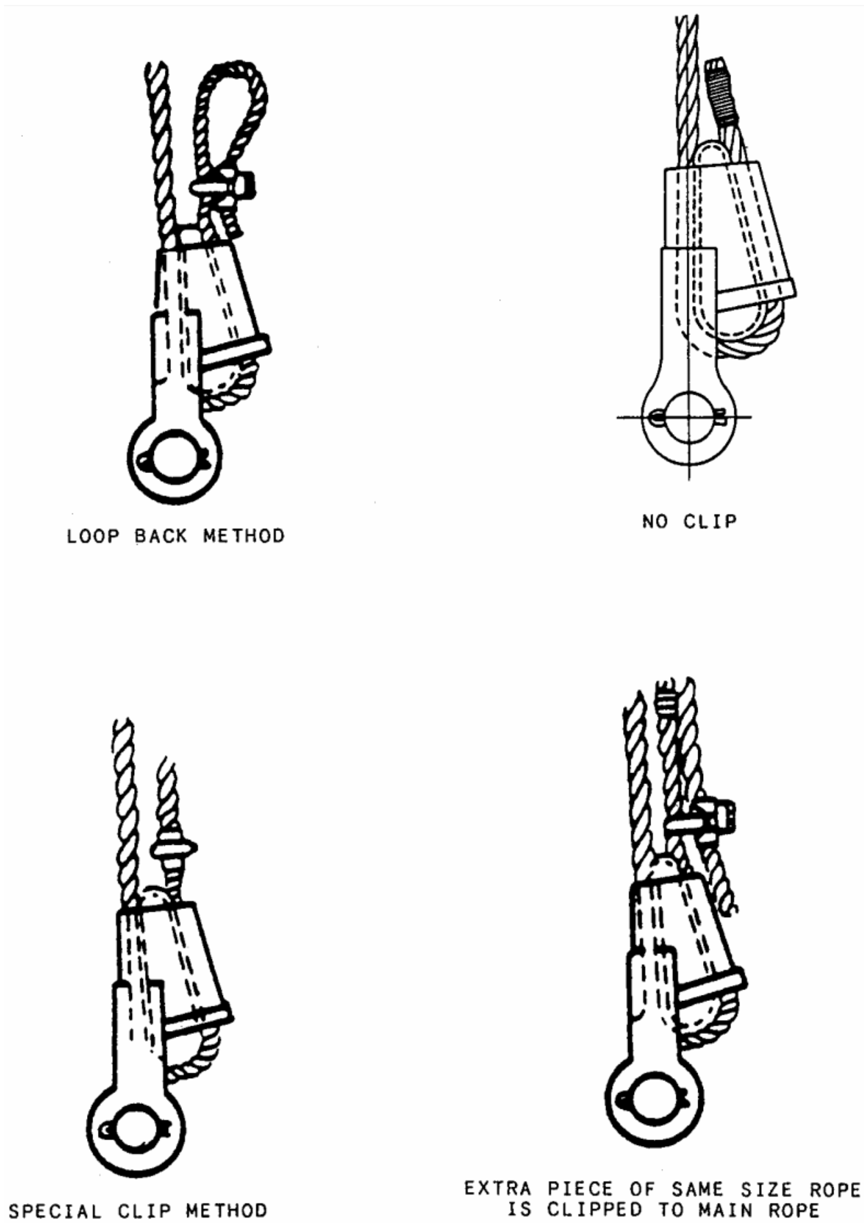


Figure 3-7.—Wedge socket clip method.

sheaves, worn or distorted sheave pins, broken bolts, and worn check weights (fig. 3-8).

The hook is inspected for damage, excessive wear to the hook safety latch, hook swivel trunnions, thrust collar, and securing nut. Also, the hook is inspected for damage or missing lubrication fittings, proper lubrication, cracks and gouges, and if visibly bent or twisted.

Before weight testing the crane, check the hook block certification. Every fifth certification, the hook block should be magna-fluxed and noted on the certification document. The magna-fluxed procedure is normally performed by the Public Works Center.

Part of the weight-testing procedure is to document the before and after hook throat opening tram point measurement (fig. 3-9). The before measurement is performed before the weight test of the crane.

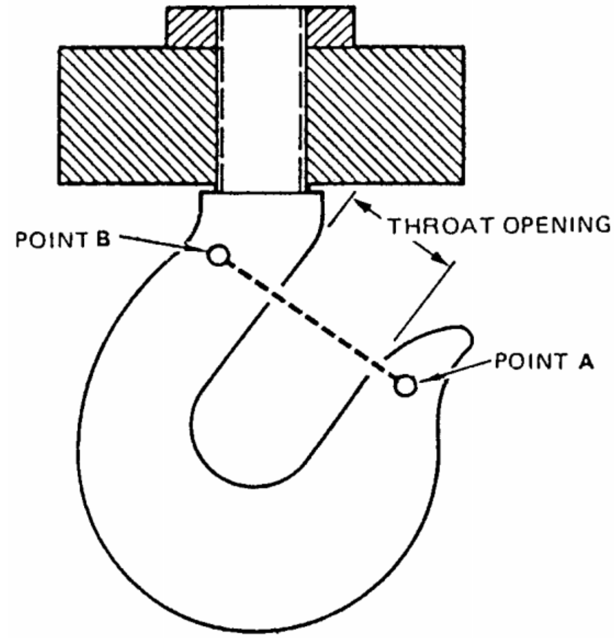


Figure 3-9.-Hook throat measurement.

Sheave Inspection

Sheaves are located in the hook block, boom point, boom bridle, gantry, and boom mast. Sheaves are installed basically anywhere wire rope must turn or bend. Sheaves rotate on either bearings or bushings that are inspected for discoloration (due to excessive heat), metallic particles, chips or displaced metal, broken or distorted bearing retainer or seals, adequate lubrication, and tight bearing caps.

The sheave inspection (fig. 3-10) is the inspection for wear and damage, wear in the wire rope sheave groove, loose or damaged sheave guards, and worn bearings and pins.

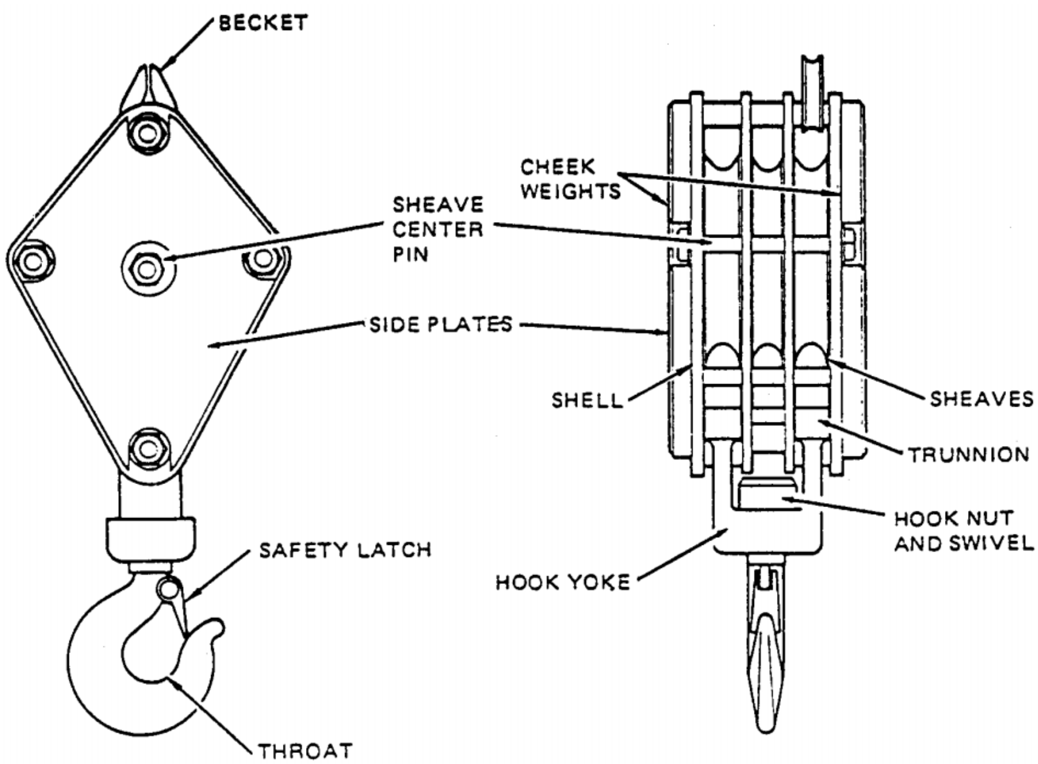


Figure 3-8.—Hook and block inspection points.

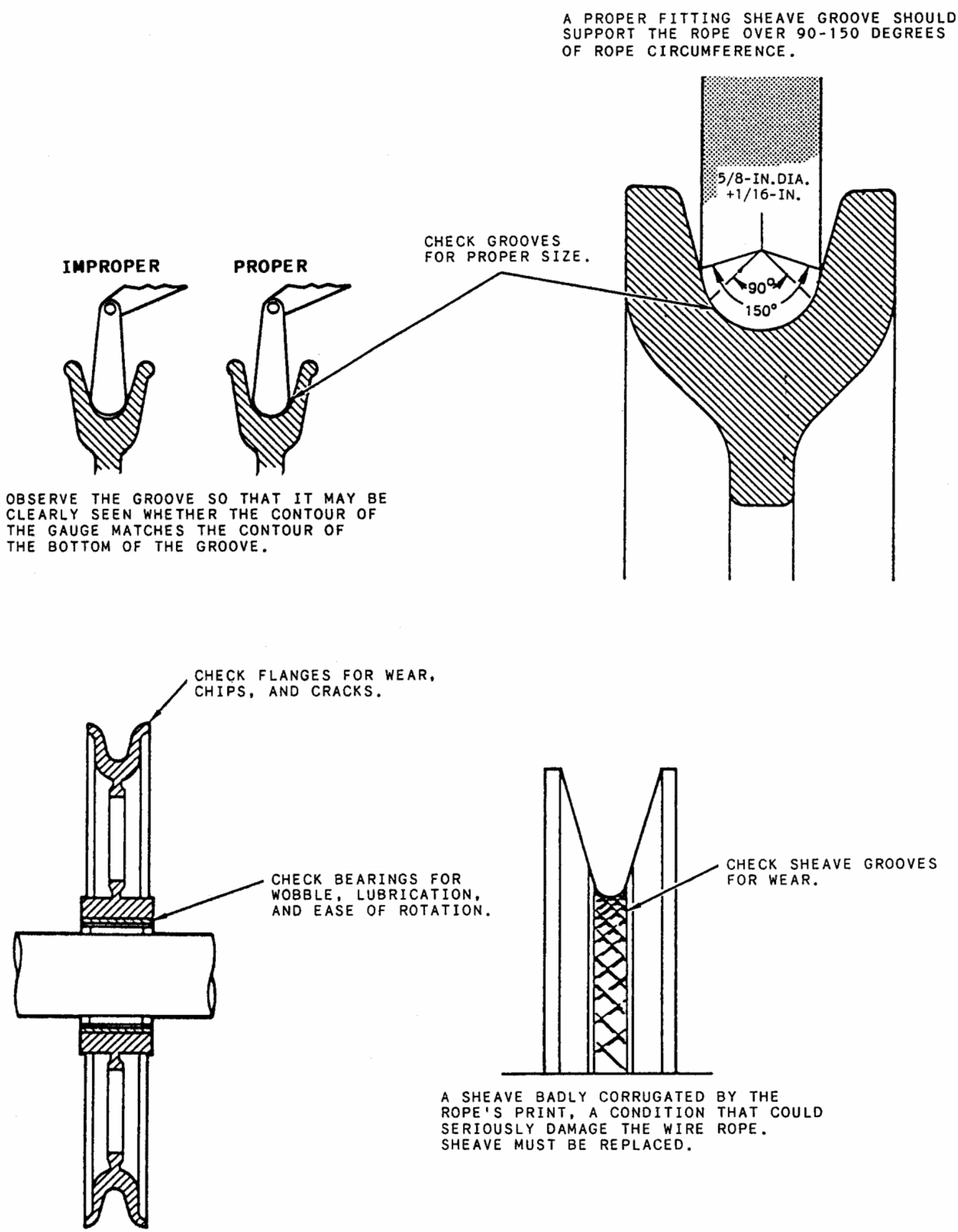


Figure 3-10.—Sheave (Pulley) Inspection.

MAXIMUM ALLOWABLE LOADS - CRANE SERVICE

BOOM LENGTH IN FEET	LOAD RADIUS IN FEET	BOOM ANGLE IN DEGREES	BOOM POINT PIN HEIGHT	WITH OUTRIGGERS SET*		WITHOUT OUTRIGGERS		
				OVER SIDE	OVER REAR	OVER SIDE		OVER REAR
						8'-0" WIDE	9'-0" WIDE	9' OR 9' WIDE
30	10	78	35'6"	*50,000	*50,000	28,800	32,200	39,300
	12	74	35'0"	*50,000	*50,000	22,500	24,900	30,800
	15	68	34'0"	*50,000	*50,000	16,800	18,500	23,200
	20	57	31'3"	36,800	*43,700	11,700	12,800	16,200
	25	44	27'3"	26,000	31,100	8,800	9,700	12,400
40	12	78	45'3"	*50,000	*50,000	22,200	24,600	30,600
	15	74	44'6"	*50,000	*50,000	16,500	18,200	22,900
	20	66	42'9"	36,600	*41,300	11,400	12,500	16,000
	25	58	40'0"	25,800	30,900	8,600	9,400	12,200
	30	49	36'3"	19,800	23,700	6,800	7,400	9,700
	35	38	30'9"	15,900	19,100	5,500	6,050	8,000
50	15	77	55'0"	*50,000	*50,000	16,400	18,000	22,700
	20	71	53'6"	36,500	*40,000	11,300	12,300	15,800
	25	65	51'6"	25,700	*30,400	8,450	9,250	12,000
	30	58	48'9"	19,600	23,600	6,650	7,250	9,500
	35	51	45'0"	15,800	19,000	5,400	5,900	7,800
	40	43	40'6"	13,100	16,800	4,500	4,900	6,600
	45	34	34'0"	11,200	13,500	3,800	4,150	5,650
60	15	79	65'3"	*48,800	*48,800	16,100	17,800	22,500
	20	74	64'0"	36,400	*39,100	11,000	12,100	15,600
	25	69	62'3"	25,500	*29,600	8,150	8,950	11,800
	30	64	60'0"	19,500	23,400	6,350	7,000	9,300
	35	59	57'3"	15,600	18,800	5,100	5,650	7,600
	40	53	53'9"	13,000	15,700	4,200	4,650	6,400
	45	46	49'6"	11,000	13,300	3,500	3,900	5,350
	50	39	44'3"	9,500	11,600	2,950	3,300	4,700
	55	32	37'9"	8,400	10,200	2,500	2,800	4,000
70	20	77	74'3"	36,200	*37,300	10,700	11,800	15,400
	25	72	73'0"	25,300	*28,800	7,850	8,700	11,600
	30	68	71'0"	19,300	*23,100	6,100	6,700	9,100
	40	59	66'0"	12,800	15,500	3,900	4,350	6,200
	50	49	58'6"	9,350	11,400	2,700	3,000	4,500
	60	36	47'6"	7,200	8,850	1,850	2,150	3,350
80	20	78	84'6"	*32,800	*32,800			
	25	75	83'3"	23,200	*28,400			
	30	71	81'9"	19,100	*22,600			
	40	63	77'6"	12,600	15,300			
	50	55	71'3"	9,200	11,200			
	60	45	62'9"	7,050	8,700			
	70	34	50'9"	5,600	6,950			
90	20	80	94'9"	*29,000	*29,000			
	25	77	93'9"	25,100	*26,000			
	30	73	92'3"	19,000	*22,200			
	40	66	88'6"	12,500	15,200			
	50	59	83'3"	9,050	11,000			
	60	51	76'3"	6,900	8,550			
	70	43	66'9"	5,450	6,800			
	80	32	53'6"	4,400	5,600			
100	20	81	105'0"	*25,300	*25,300			
	30	75	102'9"	18,800	*20,500			
	40	69	99'3"	12,300	15,000			
	50	63	94'9"	8,850	10,800			
	60	56	88'9"	6,700	8,400			
	70	49	81'0"	5,250	6,600			
	80	40	70'6"	4,200	5,350			
	90	30	56'3"	3,350	4,400			
110	20	81	115'0"	*22,000	*22,000			
	30	76	113'0"	*17,700	*17,700			
	40	71	110'0"	12,100	*14,000			
	50	65	106'0"	8,650	10,700			
	60	59	100'6"	6,500	8,200			
	70	53	93'9"	5,050	6,450			
	80	46	85'3"	4,000	5,200			
	90	38	74'3"	3,200	4,250			
	100	29	59'0"	2,600	3,500			

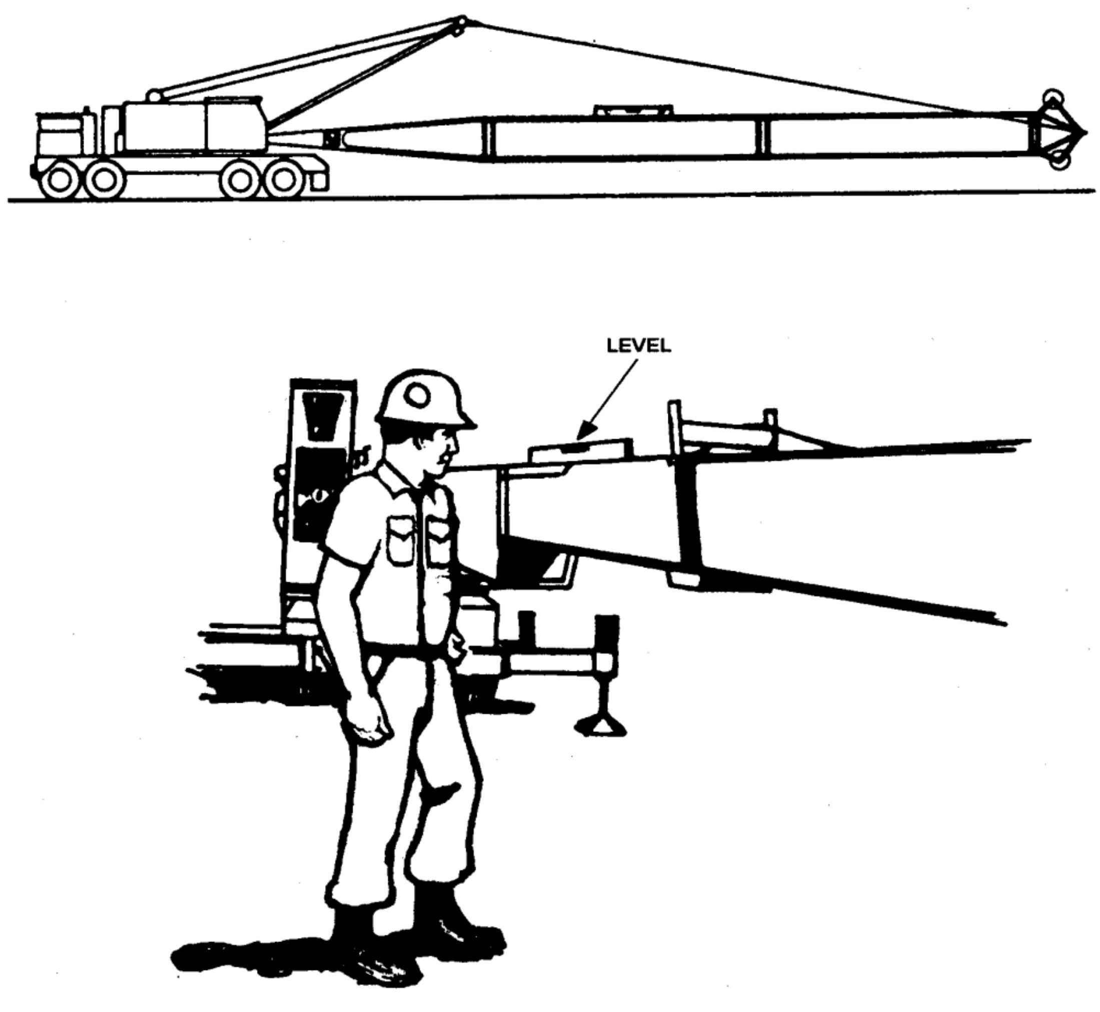
Figure 3-11.—Typical crane capacity chart.

TEST PROCEDURES

After the crane has been prestarted and transported to the test pad, the crane crew supervisors assist the crane test director to set up the weights for the weight-testing procedure. The crane crew supervisors must know the length of boom and the number of parts of line assembled on the crane. When testing cranes, you must test all the sections of boom assigned to a crane during the crane test procedures. The supervisors take the boom length measurement and the number of parts of line and review the load charts (fig. 3-11) to determine the maximum-rated allowable load that the crane can lift. Mobile cranes are weight-tested at 110 percent of the rated capacity. Crawler cranes are weight-tested at 125 percent of the rated capacity. Complete tests are performed on each hook, such as the main hoist and the auxiliary or jib hoist. All rigging used in crane load testing must have been previously tested to at least 150 percent of the rated working load.

Test Weights

To determine the test weight for a mobile crane, refer to the manufacturer's load charts assigned to the crane. To determine the test weight used in the following example, use the load chart in figure 3-11. When the crane is assembled with 60 feet of boom, the minimum radius noted on the load chart is 15 feet, with a rated capacity of 48,800 pounds. Do not rely on the boom angle indicator for radius accuracy when the lift exceeds 75 percent of the rated capacity; however, check the accuracy of the boom angle indicator by placing a 3-foot builder's level on the center boom section and raise or lower the boom until the level indicates the boom is level (fig. 3-12). At this point the boom angle indicator should show the



CHECK THE ACCURACY OF THE BOOM ANGLE INDICATOR BY USING A 3' LEVEL.

Figure 3-12.—Check accuracy of boom angle indicator.

boom is at zero degrees or adjusted to read zero degrees. Measure the radius to avoid any possibility of error. Take the 48,800 pounds and multiply it by 110 percent (48,800 x 110% or 1.10 = 53,680). The test weight for this crane example is 53,680 pounds. After the test weight is figured, you must remember that the hook blocks and rigging gear are weight that are part of the test weight.

The number of parts of line rigged on the crane is important (fig. 3-13). Most load charts will have the rated capacity of the crane for different parts of the line; for example, a crane that is capable of being rigged with a eight-part line is rigged with a six-part line. Check the load chart for the six-part line capacity; take that rated capacity and multiply it by 110 percent. The answer will be your test weight.

Another weight to figure is the weight for the stability test. The stability test requires that the maximum test load be lifted first at the maximum radius and then be swung through each manufacturer's recommended quadrant of operation for the crane, which is normally over the side and rear. Using the load chart (fig. 3-11) with the crane assembled with 60 feet of boom, the maximum radius is 55 feet. Note on the load chart a rated capacity for over the rear and over the side. Since the weight has to be transferred from one quadrant to the other as part of the test procedure, use the recommended capacity for over the side. You will find on some load charts the rated capacity will be the same for over the side and rear. The rated capacity for this example is 8,400 pounds. Multiply the 8,400 by 110 percent (1.10). (8,400 X 1.10 = 9,240.) In this case, the stability test weight is 9,240 pounds. After the test weight is figured, you must remember that the hook blocks and rigging gear are weight that are part of the test weight.

A third test weight to compute is the test weight for the auxiliary line, commonly known as the whip line. This test weight is computed by the maximum load capacity for the winch hoist or the safe working load (SWL) of the wire rope installed on the winch. You must remember that when the winch capacity is

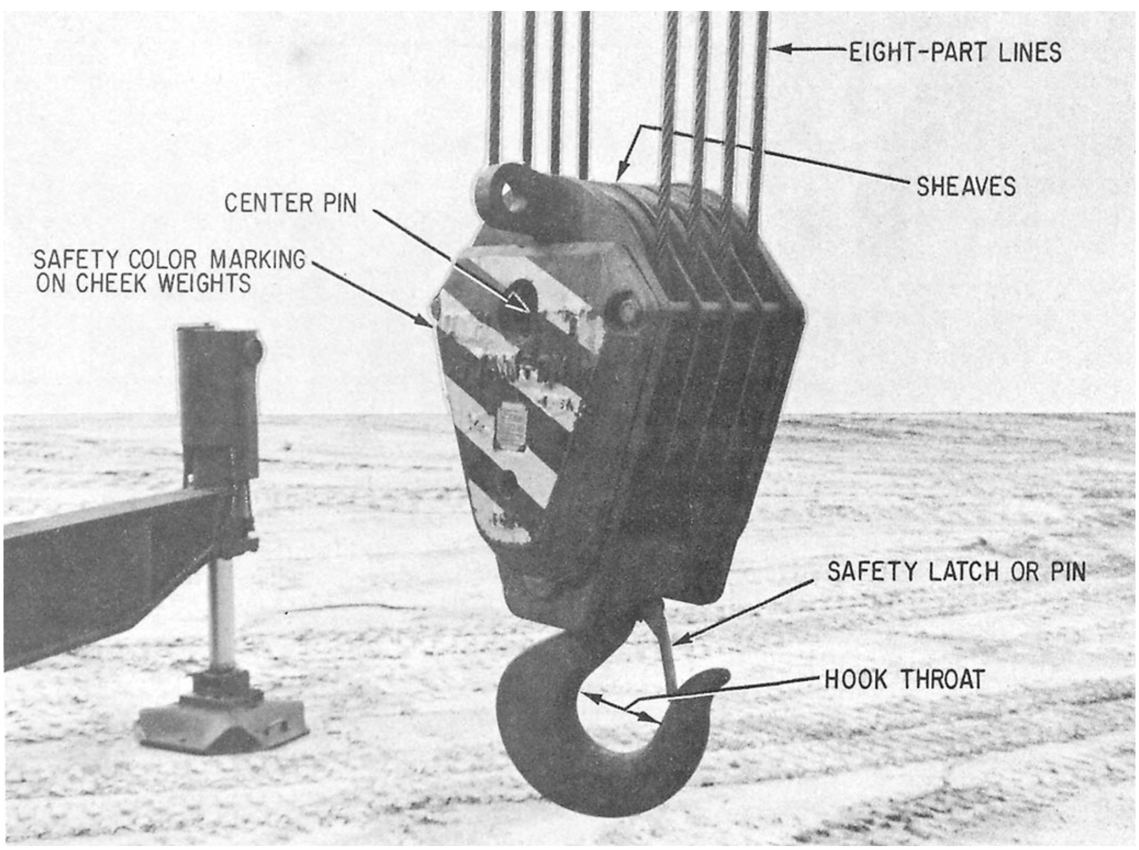


Figure 3-13.—Eight-part line hook block.

greater than the SWL of the wire rope, the test weight will be computed from the SWL of the wire rope or if the winch capacity is less than the SWL of the wire rope, the test weight will be computed from the capacity of the winch. The winch capacity is either documented on the load charts or in the manufacturer's manual.

The formula for computing the SWL for a hoist rope is the diameter of the rope squared multiplied by 8 or (D x D x 8 = SWL in tons).

Example: The wire rope on a crane is 1/2 inch in diameter. Compute the SWL for the rope.

The first step is to convert the 1/2 into a decimal number by dividing the bottom number of the fraction into the top number of the fraction: (1 divided by 2 = .5). Next, compute the SWL formula: (.5 x .5 x 8 = 2 tons). The SWL of the l/2-inch wire rope is 2 tons.

The next factor to compute is the breaking strength of the wire rope. On some wire rope spools, the nominal breaking strength of the wire rope is published; however, if the breaking strength is unknown, a break test can be performed on the wire rope. This is accomplished by cutting off sections of the wire rope and placing each section of the rope on a wire rope break test machine. The machine pulls the wire rope apart and computes the breaking strength. By testing several sections of the wire rope, you can determine the average breaking strength for that type of wire rope. Overseas, Public Works Centers normally have wire rope break test machines that can be used by the NCF. If the break test cannot be performed, the rule of thumb used for finding the breaking strength is to multiply the SWL by 5 (SWL x 5 = B.S.). For example, a l/2-inch wire rope with a SWL of 2 tons has a breaking strength of 10 tons (2 x 5 = 10 tons). REMEMBER: When the single line wire rope end connection is assembled with a wedge socket, the wedge socket only develops 70 percent of the breaking strength. Example: The crane is rigged with l/2-inch wire rope with a wedge socket end connection. The wedge socket only develops seventy percent of the l/2-inch wire rope B.S. of 10 tons, which gives the wire rope a B.S. determined by an end connection of 7 tons. Swaged socket, cappel socket, and the zinc (spelter) socket all provide 100 percent of the breaking strength when properly made.

The next factor to compute is the AWL by using the factor of safety (F.S.). To compute the allowable working load (AWL) of a wire rope, you must first understand the following wire rope safety factors:

1. Rigging rope
   a. 5 to 1 under operating conditions
   b. 10 to 1 when used to lift personnel
2. Pendants or standing rope
   a. 3.0 to 1 under operating conditions
   b. 2.5 to 1 when erecting the boom
3. Ropes that wind on drums or pass over sheaves
   a. 3.5 to 1 under operating conditions
   b. 3.0 to 1 when erecting the boom

For the auxiliary line, use the F.S. of 3.5 for wire rope that winds on drums or passes over sheaves. The formula for the F.S. is the breaking strength (B.S.), determined by the type of end connection divided by F.S. (Example: B.S. = 7 divided by 3.5 = AWL of 2 tons.)

The next factor to compute is the test weight. This is done by multiplying the AWL of 2 tons by 110 percent (2 x 110% or 2 x 1.10 = 2.2 tons). Your test weight for the l/2-inch wire rope is 2.2 tons. After the test weight is figured, you must remember that the hook blocks and rigging gear are weight that are part of the test weight.

Leveling a crane cannot be overemphasized. Cranes must be set up as per manufacturer's instruction, with the outriggers fully extended and the crane leveled. Crane capacity is lost when the crane is out of level by a few degrees (fig. 3-14). Most

Boom Length and Lift Radius	Chart Capacity Lost When Crane Out of Level By		
	1°	2°	3°
Short Boom, Minimum Radius	10%	20%	30%
Short Boom, Maximum Radius	8%	15%	20%
Long Boom, Minimum Radius	30%	41%	50%
Long Boom, Maximum Radius	5%	19%	15%

Figure 3-14.-Crane capacity lost by crane out of level.

cranes have levels mounted on them, but the levels are not always accurate. Use a 3-foot builder's level to check the level of the crane over the rear and over the sides (fig. 3-15).

After the test weights are figured, you must remember that the hook blocks and rigging gear are weight that are part of the test weight. The maximum test weight for this example is set up at the 15-foot radius measurement over the side of the crane. Crane radius is the measurement from the center of rotation to the center of the hook (fig. 3-16).

The crane is weight-tested with the boom rotated ninety (90) degrees from the longitudinal axis of the crane carrier. It is strongly recommended by NAVFAC P-307 that precautions, such as attaching guy wires to the mane or placing cribbing under the counterweight, be used to preclude possible overturning of the crane in the event of wire rope or mechanical failure. Cribbing is normally used in the NCF.

Before testing of the crane can proceed, the crane test mechanic and the certifying officer must be present at the test site. The crane test mechanic and the crane test director will perform and complete the BDA inspection during and after the testing of the crane. This document must be signed by the test mechanic and test director.

One purpose of weight testing the crane is to check and make sure the hydraulic rams on the outriggers support the crane and the maximum lifted load. A way to check the hydraulic rams is with a grease pencil and a ruler. Measure from a known vertical point on the hydraulic ram housing and place a line with the grease pencil on the ram (fig. 3-17).

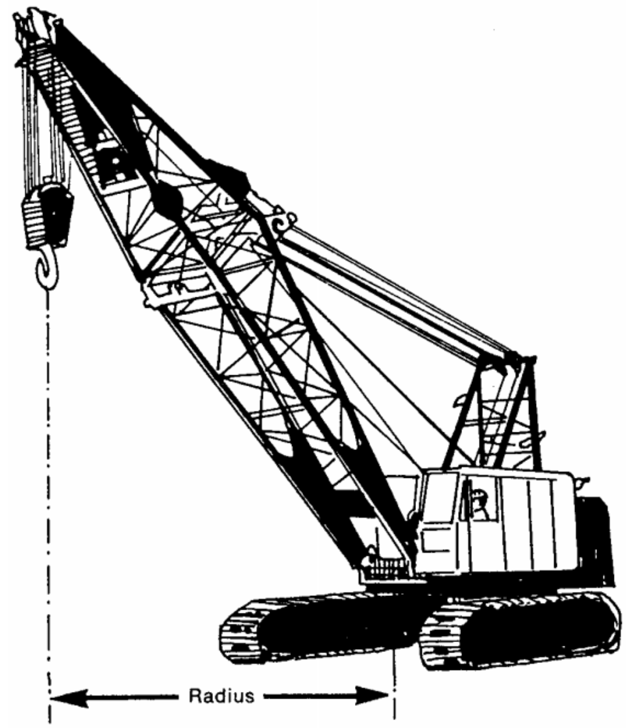


Figure 3-16.—Crane radius.

After each test, measure this known measurement, and this will enable you to make sure there is no slippage in the hydraulic system.

5.4 No-Load Test

The first part of the crane test procedure is the no-load test. The procedure is as follows:

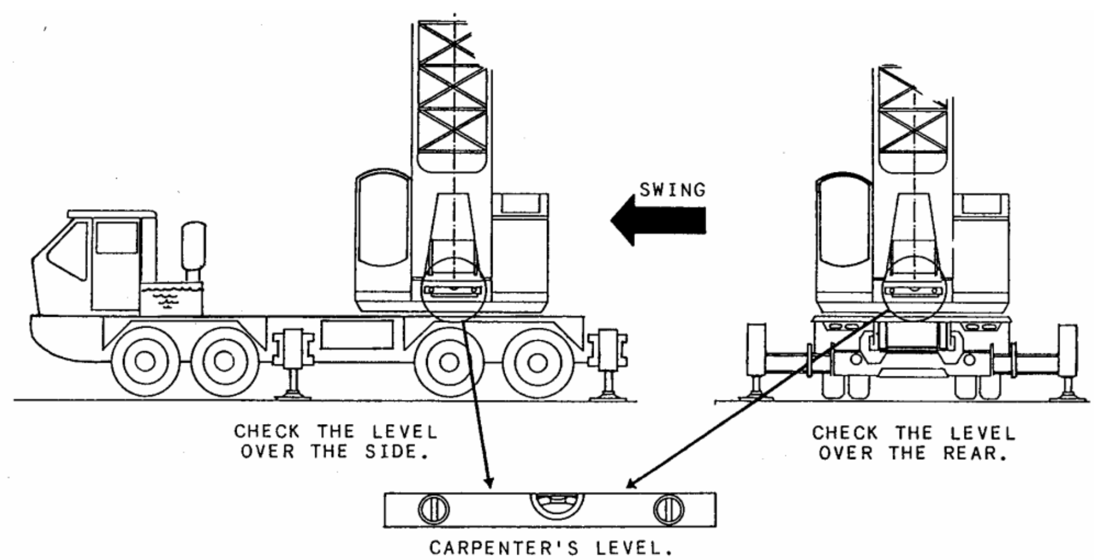


Figure 3-15.—Builder's level leveling procedures.

5.4.1 Hoist.

1. Raise and lower the hook through the full-working distance of hook travel.

2. Run the hoist block into the limit switch or switches, if installed, at slow speed.

3. Run the hoist block beyond the limit switch or switches by using the bypass switch.

5.4.2 Boom.

1. Raise and lower the boom through the full-working range.

2. Raise the boom into the upper limit switch (when installed). Raise the boom past the boom upper limit switch using the bypass switch.

3. Test the lower limit switch (when installed) by the same proecdure prescribed for testing the upper limit switch.

4. Extend and retract telescoping boom sections their full distance of travel.

5. Check the radius indicator by measuring the radius at the minimum and maximum boom angle.

5.4.3 Motion.

Other motions, including swing, shall be operated through one cycle (one-full revolution of major components).

5.5 Load Test

The load test consists of basically two parts: a maximum load test and a stability test. The following test sequence is time and cost cffcctivc. The sequence may be varied by the activity.

5.5.1 Maximum Test Load for the Crane on Main Hoist.

1. Static Test. Raise the test load to clear the ground with the boom at minimum radius and hold for 10 minutes without boom and load hoist pawls (dog) engaged. Rotate the load and hook to check bearing operation. Observe any lowering that may occur that may indicate a malfunction of the boom or hoisting components, brakes, or outriggers. For hydraulic cranes, tests are performed with the boom fully retracted and fully extended.

2. Dynamic Test. Raise and lower the test load at normal operating speeds. Lower the test load to the ground until the hoist lines are slack. Wait 5 minutes, hoist test load, and continue on with the test.

3. Hoist Brake. Test the ability of the brake to control and stop the load (fig. 3-18). Test the ability of the brake to hold and lower the test load with the friction clutch disengaged, if applicable.

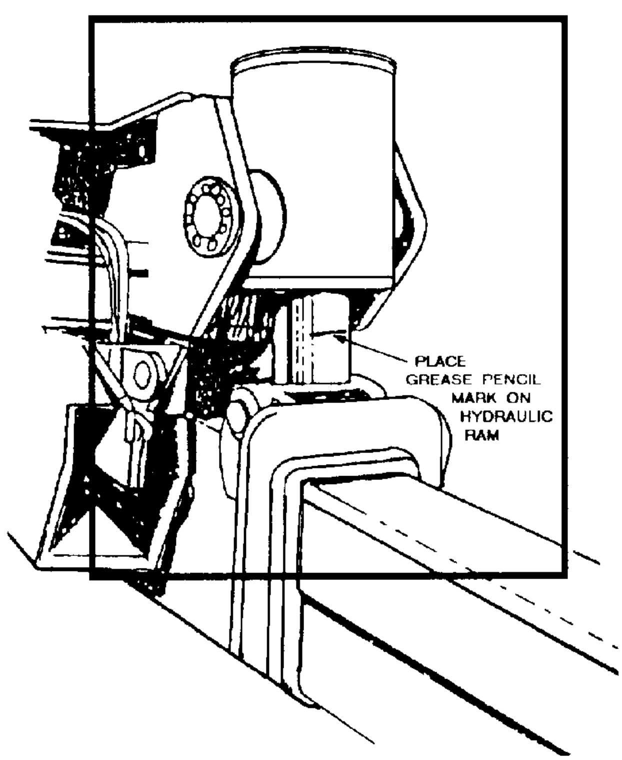


Figure 3-17.—Marking hydraulic rams.

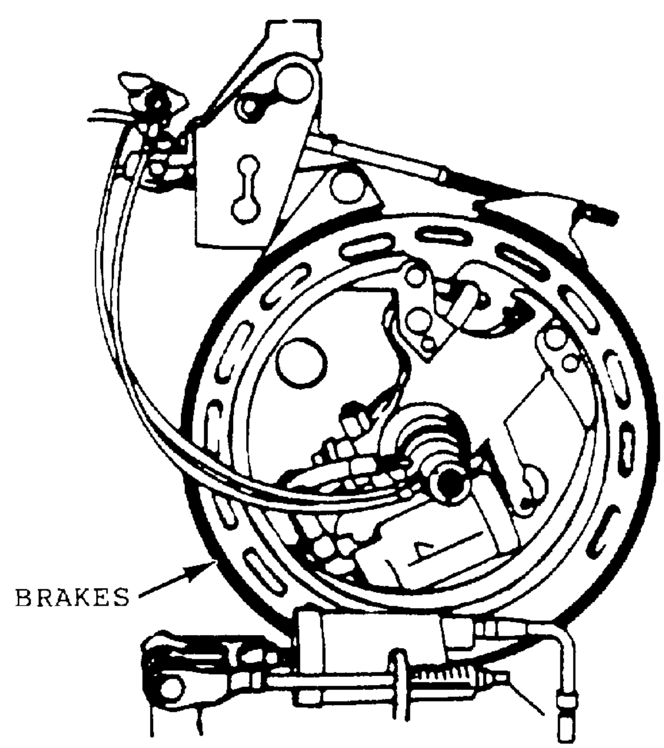


Figure 3-18.-Hoist brake.

4. Boom Operation. Operate the boom from minimum radius to maximum radius for the load applied.

5. Hydraulic Crane Slippage. Lift the test load at maximum radius and allow time for fluid and component temperatures to stabilize. Hold the load for 10 minutes without the operator using the controls. There should be no significant lowering of the load, boom, or outrigger beam due to a component or system malfunction or failure during the test. The significance of any lowering shall be evaluated by the certifying officer, depending on operating requirements and safety.

5.5.2 Maximum Test Load at Maximum Radius of Crane (Stability Test)

1. Boom Operation. Raise and lower the boom through the full-working range. Visually observe for smooth operation. Test the boom brake for proper operation. For hydraulic cranes, the test is performed with the boom fully retracted and fully extended.

2. Rotation. Rotate the crane left and right the maximum degrees allowed by the manufacturer at slow speed. Apply the brake periodically during rotation. The brake should have the ability to stop the rotating motion in a smooth, positive manner.

NOTE: Where brakes are designed for holding only, operate controls (plugging) to stop rotation then apply brakes. Test shall be performed with boom fully retracted and fully extended.

3. Hydraulic Crane Slippage. Lift the test load at maximum radius and allow time for fluid and component temperatures to stabilize. Hold the load for 10 minutes without the operator using the controls. There should be no significant lowering of the load, boom, or outrigger beams due to a component or system malfunction or failure during the test. The significance of any lowering shall be evaluated by the certifying officer, depending on operating requirements and safety.

5.5.3 Auxiliary and Jib Hoist.

The test load should be the maximum load for the hoist.

1. Static Test. Raise the test load to clear the ground and hold for 10 minutes. Observe any lowering that occurs that may indicate a malfunction of the hoisting components or brakes.

2. Dynamic Test. Raise and lower the test load at normal operating speeds. Lower the test load to the ground until the hoist lines are slack. Wait 5 minutes, hoist the test load, and continue the test.

3. Hoist Brake Test. Test the ability of the brake to control and stop the load. Next, test the ability of the brake to hold and lower the test load with the friction clutch disengaged, if applicable.

5.5.4 Free-Rated Load Test.

To check the stability of the crane and operation of the crane carrier, wheels, tires, tracks, brakes, and so forth, under load. Retract outriggers before beginning the free-rated test.

CAUTION

ATTACH TAG LINES TO THE LOAD TO CONTROL OSCILLATION.

NOTE: No static test is required (not applicable to mobile cranes temporarily mounted on barge).

1. Hoist the maximum free-rated test load at the maximum radius over the rear.

a. Rotate the load through the "over the rear" working arc.

b. Travel a minimum of 50 feet with the test load held over the rear of the crane with the boom parallel to the longitudinal axis of the crane carrier.

2. Hoist the maximum free-rated test load at the maximum radius over the side.

a. Rotate the load through the full-working range.

b. Travel a minimum of 50 feet with the test load over the left and then the right side of the crane carrier with the boom 90 degrees to the axis of travel.

As outlined in the COMSECOND/COMTHIRDNCBINST 11200.1 series, rated free loads or pick and carry operations are only performed according to *NAVFAC P-307* during a certification, in case of an emergency, or as directed by the crane certifying officer.

5.5.5 Test After Change or Repair of Tires.

After change or repair of tires, the crane should be tested with the maximum free-rated test load over the affected tire(s). Raise and hold the test load for 10 minutes while observing the changed or repaired tire(s).

5.6 Weight-Handling Equipment Used for Other Than Lift Crane Service.

Locomotive, crawler, truck, and cruiser cranes used for clamshell, dragline, magnet, pile driving, or other nonlift crane work should be tested at the maximum safe working load permitted for the size wire rope being used. This test should be performed in all working motions except travel. Buckets, magnets, and so forth, may be removed for testing wire rope. No test is required after reassembly. Retesting is not required when the end attachment is changed from the original connection (that is, changed from clamshell use to dragline, and so on) during the certification period.

Load Test Certification

After the test, the crane test mechanic and the crane test director will jointly perform an after inspection of the crane. This inspection is documented on the Crane Condition Inspection Record.

Upon successful completion of the inspection and load test, the certification of the load test and condition inspection (fig. 3-19) must be prepared in triplicate. The following items are documented on this form:

1. USN number of the crane
2. Type of crane
3. Rated capacity of the crane
4. Boom length of the crane
5. Location
6. Test date
7. Reason for test

Crane No.	Type	Rated Cap	Boom Length	Location	Test Date
82-00001	P&H	lbs. 48800 feet 15'	60	CAMP COVINGTON, GUAM	5-26-92

Reason for Test ANNUAL CERTIFICATION

Category 1 Cranes

Hoist	Test Load %	Minimum Radius Pounds	Minimum Radius Feet	Maximum Radius Pounds	Maximum Radius Feet
Main	110	53680	15	9240	55
Aux	110	4400	—	—	—
Whip	NA	—	—	—	—

Hook Throat Opening	Before Test	After Test
Main Hook	4 7/64	4 7/64
Aux Hook	3 1/64	3 1/64
Whip Hook		

Category 2 Cranes

Hoist	Test Load %	Minimum Radius Pounds	Minimum Radius Feet	Maximum Radius Pounds	Maximum Radius Feet
Main					
Aux					

Hook Throat Opening	Before Test	After Test
Main Hook		
Aux Hook		

Category 3 Cranes

Hoist	Test Load %	Pounds	Hook Throat Opening Before Test	Hook Throat Opening After Test
Main				
Aux				
Main 100% Test				

Remarks:

NA

Certification

This is to certify that inspections and tests have been conducted in accordance with the crane test procedures set forth in the current Naval Facilities Engineering Command P-307, Volume 1

1.4.1	5.4.2.d
1.4.2	5.4.2.e
1.4.3	5.4.3
1.5.1	5.6.1.a
1.5.2	5.5.1.b
1.6	5.5.1.c
5.1	5.5.1.d
5.3	5.5.2.(a)
5.4.1	5.5.2.(b)
5.4.1.a	5.5.3.(a)
5.4.1.b	5.5.3.(b)
5.4.1.c	5.5.3.(c)
5.4.2.a	
5.4.2.b	
5.4.2.c	

Crane Condition Inspection Record Item Numbers
Check (✓) Items Inspected

1 ✓	6 ✓	11 ✓	16 ✓	21 ✓	26 ✓	31 ✓	36 NA
2 ✓	7 ✓	12 ✓	17 ✓	22 ✓	27 ✓	32 ✓	37 NA
3 ✓	8 ✓	13 ✓	18 ✓	23 ✓	28 ✓	33 ✓	38 NA
4 ✓	9 ✓	14 ✓	19 ✓	24 ✓	29 ✓	34 NA	39 NA
5 ✓	10 ✓	15 ✓	20 ✓	25 NA	30 ✓	35 NA	40 NA

It is further certified that the crane identified above is satisfactory to lift its rated capacity at its rated radii

Test Director (Signature) Walter T. Door	Date 5-26-92
Inspector (Signature) Jack R. Frost	Date 5-26-92
Certifying Official (Signature) Able B. Seaman	Date 5-26-92

Figure 3-19.—Certification of Load Test and Condition Inspection.

8. Hook tram point measurements (before and after measurements)

9. Test weights lifted

10. Crane condition inspection record item numbers inspected

11. Test procedures paragraph numbers performed, as outlined in NAVFAC P-307

The memorandum must be signed by the test director, the mechanical inspector, and the certifying officer. The original is filed in the appropriate equipment history jacket. One copy is filed in the unit safety office, and the second copy is kept in an accessible protected container on the crane. The certification date is stenciled with 3-inch stencils on the operator's side of the revolving house.

Frequency of Test

The command schedules each crane for periodic condition and load tests. Test are conducted before placing any crane into initial use. Cranes stored or idle for 6 months or more must be inspected and tested before returning to service. ANY MACHINE THAT HAS HAD MAJOR REPAIRS OR REPLACEMENT OF LOAD BEARING OR CONTROLLING PARTS WILL ALSO BE TESTED BEFORE IT IS PUT BACK IN SERVICE. The definitions of load bearing and controlling are only those parts and components that support the load and whose failure would result in uncontrolled dropping, shifting, or moving of the load. Tests may be conducted as frequently as local authorities deem advisable (not to exceed 12 months between tests).

After the crane has passed the test procedures, the mechanics will place the NMCB unit identification marking decal on the crane in the correct locations.

Extension of Certification

The commanding officer may approve in writing a temporary extension of the prior annual certification when an emergent or other contingent conditions exists precluding the timely certification of the crane. <u>The authority to extend certifications cannot be delegated.</u> Before you extend the certification, the crane must pass a complete condition inspection.

CRANE SAFETY

Loss in terms of lives, injuries, and equipment can bc dccrcascd with positive action and the use of safe operating techniques by all Seabees working on or around cranes.

Stability

Most crane mishaps result from operator error. Setting up for the lift is the most critical portion of the crane operation. The most common causes of mishaps are as follows:

1. Failure to block/crib under the outriggers pads where poor ground conditions would not support the total weight of the crane and load.

2. Failure to extend the outriggers fully and use it following the manufacturer's instructions.

3. Failure to note overhead obstructions, such as overpasses and power lines.

4. Failure to level the crane.

Load Capacity

The rated capacities of mobile cranes are based on both <u>strength</u> and <u>stability.</u> Manufacturers of cranes will normally denote on the load charts a shaded area or a bold line across the chart dividing the lifting capacities based on strength or stability of the crane. It is extremely important to know the difference for, in one case, one of the structural components of the crane will break, and in the other case, the crane will tip over. The following factors must also be recognized and the capacity adjusted accordingly:

1. Do not use stability to determine lifting capacity. Use the load chart installed by the crane manufacturer. The load chart is securely attached in the operator's cab.

2. Recommended parts of hoist reeving and the recommended size and type of wire rope for various crane loads.

3. Length of boom.

4. Boom angle.

5. Boom pendant angle (when the telescopic/folding gantry is down, the angle decreases and the stress increases).

6. Gantry and/or live mast in the highest position.

7. Quadrant of operation (that is, over the side, over the rear capacities).

CAUTION

DO NOT RELY ON THE BOOM ANGLE INDICATOR FOR RADIUS ACCURACY WHEN LIFTS EXCEED 75 PERCENT OF THE RATED CAPACITY. MEASURE TO AVOID THE POSSIBILITY OF ERROR.

NOTE: Capacity charts do not apply if the machine has been modified in any way. Rated capacity is based on the machine as it was originally manufactured and equipped.

Safe Lifting

The following factors will give you some basic guidelines of what you must know to perform safe daily crane operations:

1. Determine the weight to be lifted and the crane required to make the lift safely.
2. Travel the proposed route the crane will follow to and from the project site, and complete the Crane Lift Checklist.
3. Obtain the travel permits if required.
4. Brief operators and riggers on the specifics of the lift and travel conditions.
5. Inspect the crane area setup for stability and safe operating area.
6. Fully extend the outriggers and use them according to the manufacturer's instructions.
7. Check the machine for levelness.
8. Inspect slings, spreader bars, and all other hardware being used.
9. Select the proper sling with sufficient capacity rating.
10. Center the sling in the base (bowl) of the hook to avoid hook point loading, and ensure that the hook block is always placed over the center of the load to eliminate shock loading of the slings or cranes resulting from load shifts when a lift is made.
11. Make ample safety allowances for unknown factors.
12. Stand clear of and do not walk under suspended loads.
13. Boom deflection. All crane booms have deflection. When the load is lifted off the ground, the boom will deflect causing the radius to increase. Increased radius may cause overloading of the crane.
14. Clean operating area. Water coolers, excess tools, grease, soda cans, and other unnecessary items should be located outside the operating area of the crane. Water coolers must be kept off the crane to prevent people from walking around the crane when in operation.
15. Weight on outriggers. On lattice booms, about 60 percent of the load is on the outriggers close to the load. On hydraulic cranes during near capacity lifts at high boom angles, about 60 percent of the load is on outriggers away from the load.

ATTENTION: SAFE LIFTING IS PARAMOUNT! PROJECT COMPLETION MUST NOT INTERFERE WITH SAFE CRANE OPERATIONS!

Training

For deployed units, COMSECOND/COMTHIRDNCBINST 11200.1 series requires biweekly crane operation and safety meetings be conducted. The meetings review crane operations and include general safety, minimum rigging procedures, crane and rigging responsibilities, and upcoming lifts. The Alfa company commander, crane test director, crane supervisor and operators/riggers should attend the meetings.

Mishap Reporting

In addition to the requirements outlined in COMSECOND/COMTHIRDNCBINST 5100.1 series, any mishap involving NCF cranes must be reported by message to the COMTHIRDNCB DET, Port Hueneme, California, or the COMSECONDNCB DET, Gulfport, Mississippi.

WIRE ROPE SLINGS AND RIGGING HARDWARE

The use of slings, hooks, spreader bars, shackles, and so forth, for lifting is a vital link in the weight-handling process. An in-depth management program for the maintenance and use of slings is required to ensure the entire weight-handling operations are performed safely and professionally. The crane crew supervisors are responsible for the inspection and turnover of all slings and rigging gear during the BEEP.

Slings

Wire rope slings require special attention due to being subjected to severe wear, abrasion, impact loading, crushing, kinking, and overloading. Failure to provide blocking or protective pads permits sharp corners to cut into the sling. Pulling slings from under loads results in abrasion and kinking. Dropping loads on slings or running equipment over slings will cause crushing. Sudden starts and stops when lifting loads will increase stress on the sling. The recommended factor of safety for wire rope slings is 5:1 due to the severe service expended on slings, errors made in determining load weights, and the effects of sling stress from sling angles (fig. 3-20).

Single-Vertical Hitch

The single-vertical hitch (fig. 3-21) is a sling that supports a load by a single vertical part or leg of the

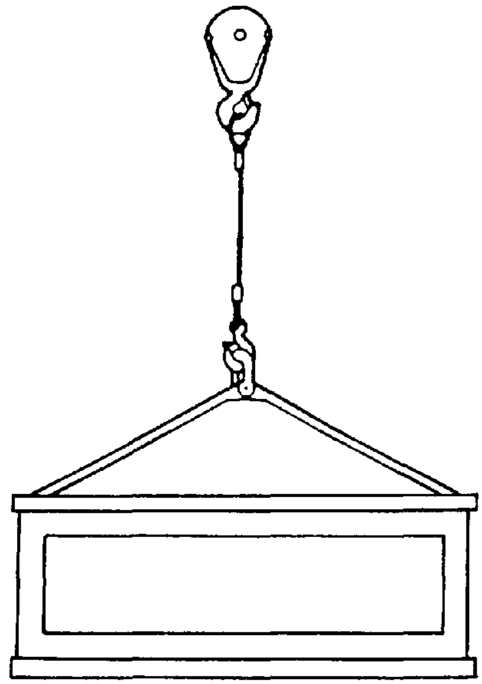


Figure 3-21.-Single-vertical hitch.

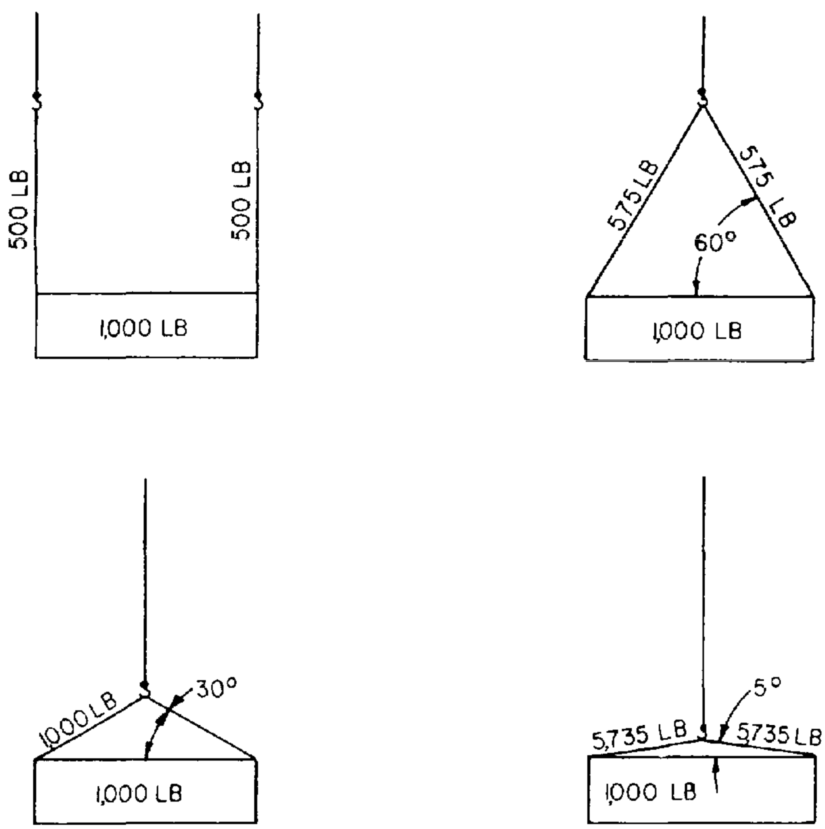


Figure 3-20.-Sling stress.

sling. The total weight of the load is carried by a single leg with the sling angle of 90 degrees.

Bridle Hitch

The bridle hitch can consist of two, three, or four single hitches (fig. 3-22), used together to form a bridle hitch for hoisting an object.

The bridle hitch provides excellent load stability when the load is distributed equally among the legs, the load hook is directly over the center of gravity of the load, and the load is raised level. The use of a bridle sling requires that the sling angles be carefully determined to ensure that the individual legs are not overloaded. It is wrong to conclude that a three- or four-leg bridle hitch will safely lift a load equal to the safe load on one leg multiplied by the number of legs, because there is no way of knowing that each leg is carrying its share of the load. With a four-legged bridle sling lifting a rigid load, it is possible for two of the legs to take practically the full load while the other two only balance it. COMSECOND/COMTHIRDNCB strongly recommend that the rated capacities for two-leg bridle slings listed in the COMSECOND/COMTHIRDNCBINST 11200.11 series be used also as the safe load of three- or four-leg bridle hitches.

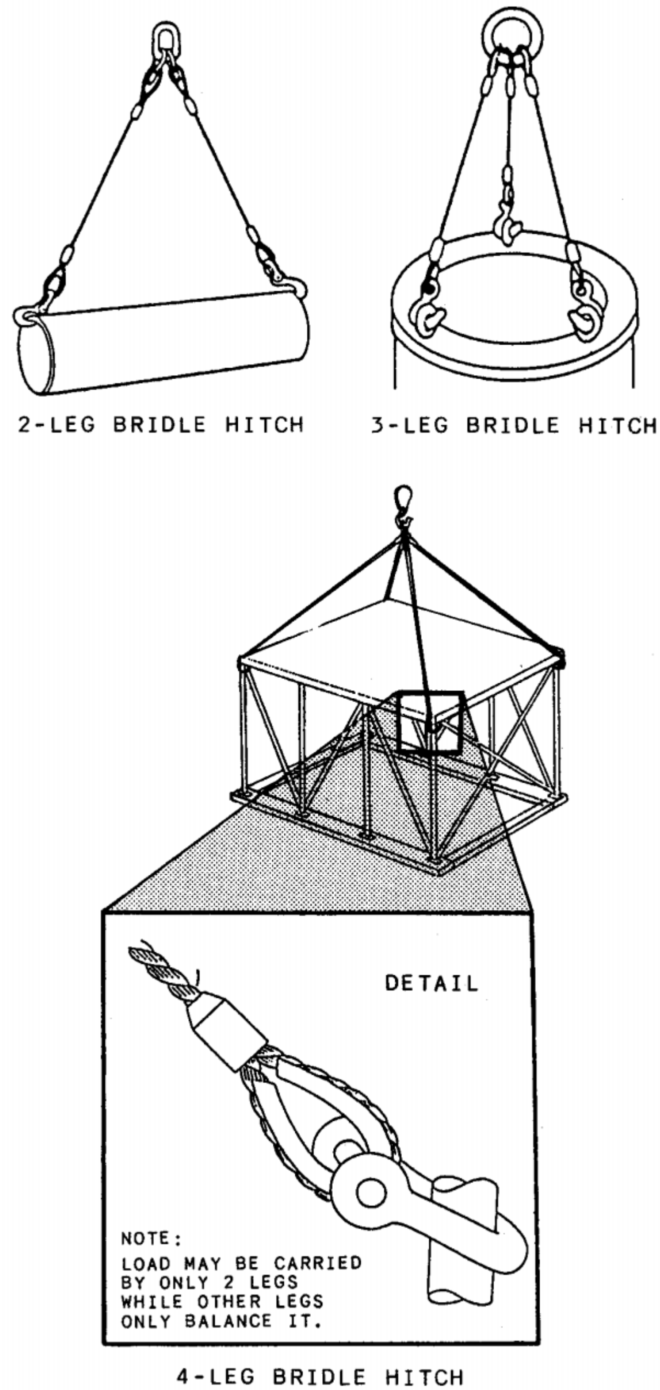


Figure 3-22.—Bridle hitch.

Sling Angle

The rated capacity of any sling depends on the size, the configuration, and the angles formed by the legs of the sling and the horizontal. A sling with two legs used to lift a 1,000 pound object will have 500 pounds of the load on each leg when the sling angle is 90 degrees. The load stress on each leg increases as the angle decreases; and if the sling angle was 30 degrees lifting the same 1,000 pound object, the load will be 1,000 pounds on each leg. Try to keep all sling angles greater than 45 degrees; sling angles approaching 30 degrees are considered extremely hazardous and must be avoided at all cost.

Sling Safe Working Loads

It is a difficult task to remember all of the load, size, and sling combinations; however, the following rules of thumb work well for estimating the loads in the most sling configurations.

The rules of thumb are based on the safe working load of the single vertical hitch of a particular sling. The efficiencies of the end fittings used also have to be considered when determining the capacity of the combination.

The formula used to compute the safe working load (SWL) for a bridle hitch with two, three, or four legs (fig. 3-23) is SWL (of single vertical hitch) x H (Height) divided by L (Length) x 2 = SWL. When the sling legs are not of equal length, use the smallest H/L measurement. This formula is for a two-leg bridle hitch but it is strongly recommended it also be used for the three- and four-leg hitches.

However, do not forget it is wrong to assume that a three- or four-leg hitch will safely lift a load equal to the safe load on one leg multiplied by the number of legs.

Other formulas are as follows:

Single-Basket Hitch (fig. 3-24): For vertical legs, SWL = SWL (of single-vertical hitch) x 2.

For inclined legs, SWL = SWL (of single-vertical hitch) x H divided by L x 4.

Double-Basket Hitch (fig. 3-25): For vertical legs, SWL = SWL (of single-vertical hitch) x 4.

For inclined legs, SWL = SWL (of single-vertical hitch) x H divided by L x 4.

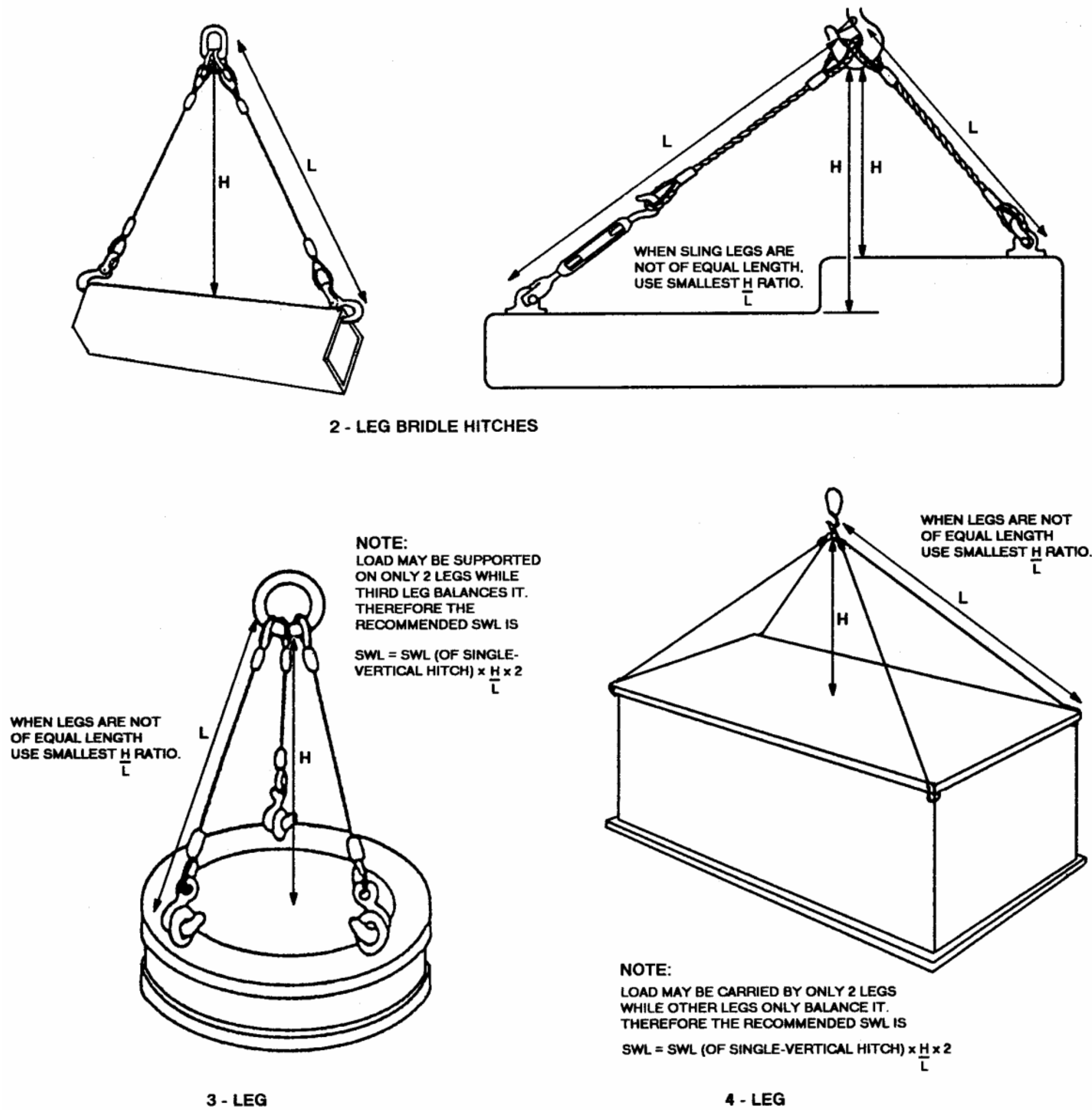


Figure 3-23.—Determination of bridle hitch sling capacity.

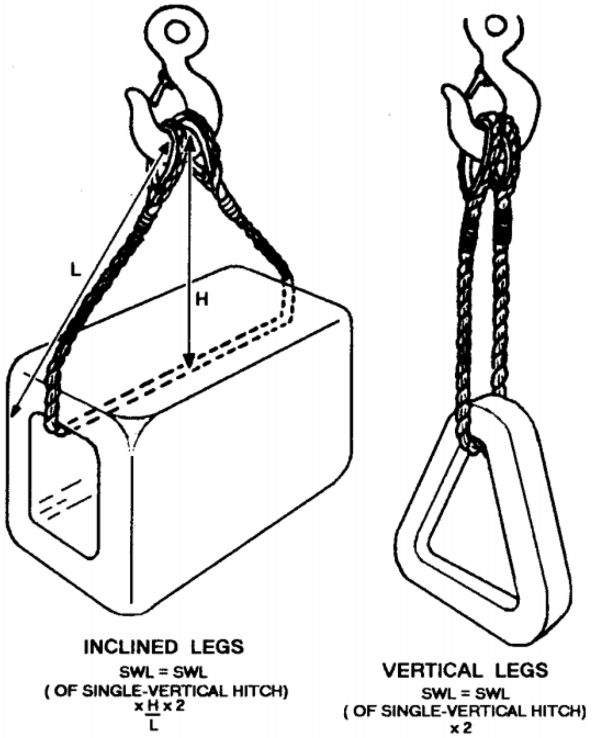


Figure 3-24.—Determination of single-basket hitch sling capacity.

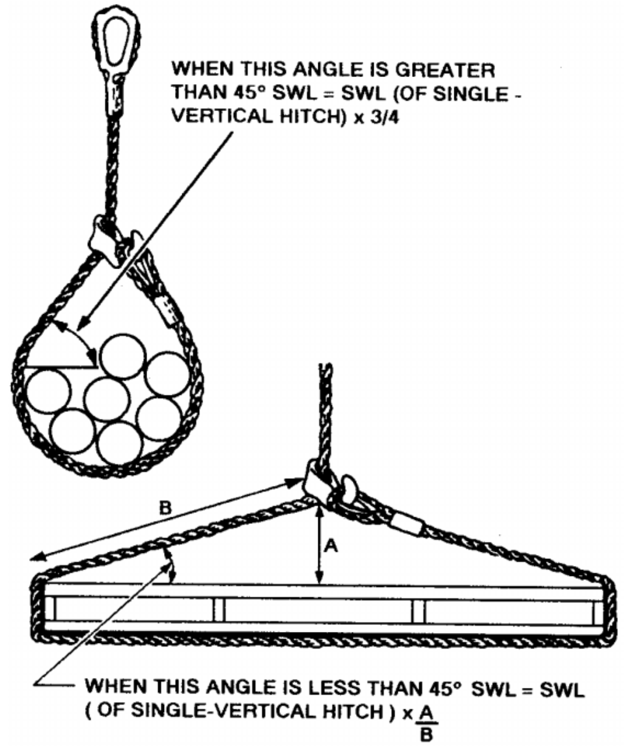


Figure 3-26.—Determination of single-choker hitch sling capacity.

Single-Choker Hitch (fig. 3-26): For sling angles of 45 degrees or more, SWL = SWL (of single-vertical hitch) x 3/4 or .75.

Sling angles of less than 45 degrees are not recommended; however, if they are used, the formula is SWL = SWL (of single-vertical hitch) x A/B.

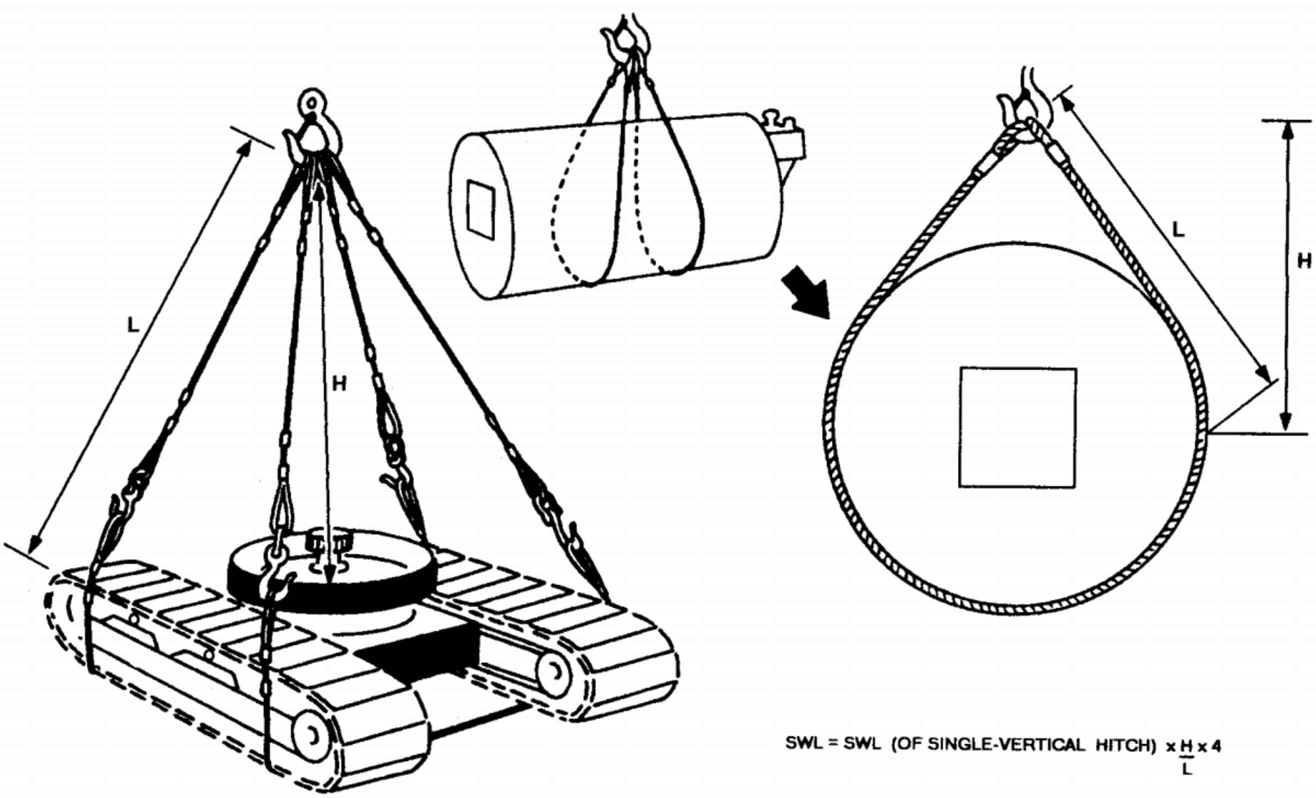


Figure 3-25.—Determination of double-basket hitch sling capacity.

Double-Choker Hitch (fig. 3-27): For sling angle of 45 degrees or more, SWL = SWL (of single-vertical hitch) x 3 divided by 4 x H divided by L x 2.

Sling angles of less than 45 degrees, SWL = SWL (of single-vertical hitch) x A divided by B x H divided by L x 2.

Eye Splices

Most of the attachments used with wire rope are designed to provide an eye on the end of the wire rope by which the maximum strength of the wire rope can be obtained when the wire rope is connected to a load. With the exception of some slings, all spiced eyes should incorporate rope thimbles to maintain rope strength and reduce wear. If a thimble is not used, the efficiency of the connection can be reduced by as much as 10 percent because the rope flattens under the load (fig. 3-28).

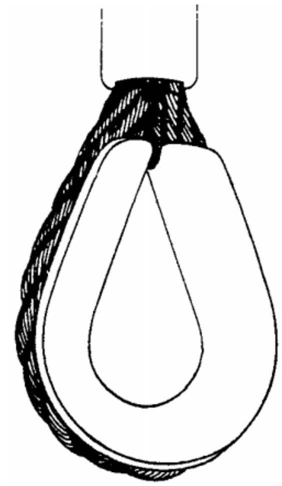


Figure 3-28.-Wire rope thimble.

Every wire rope manufacturer attaches a different name to its particular type of eye splice; however, there are usually variations in the three basic groups:

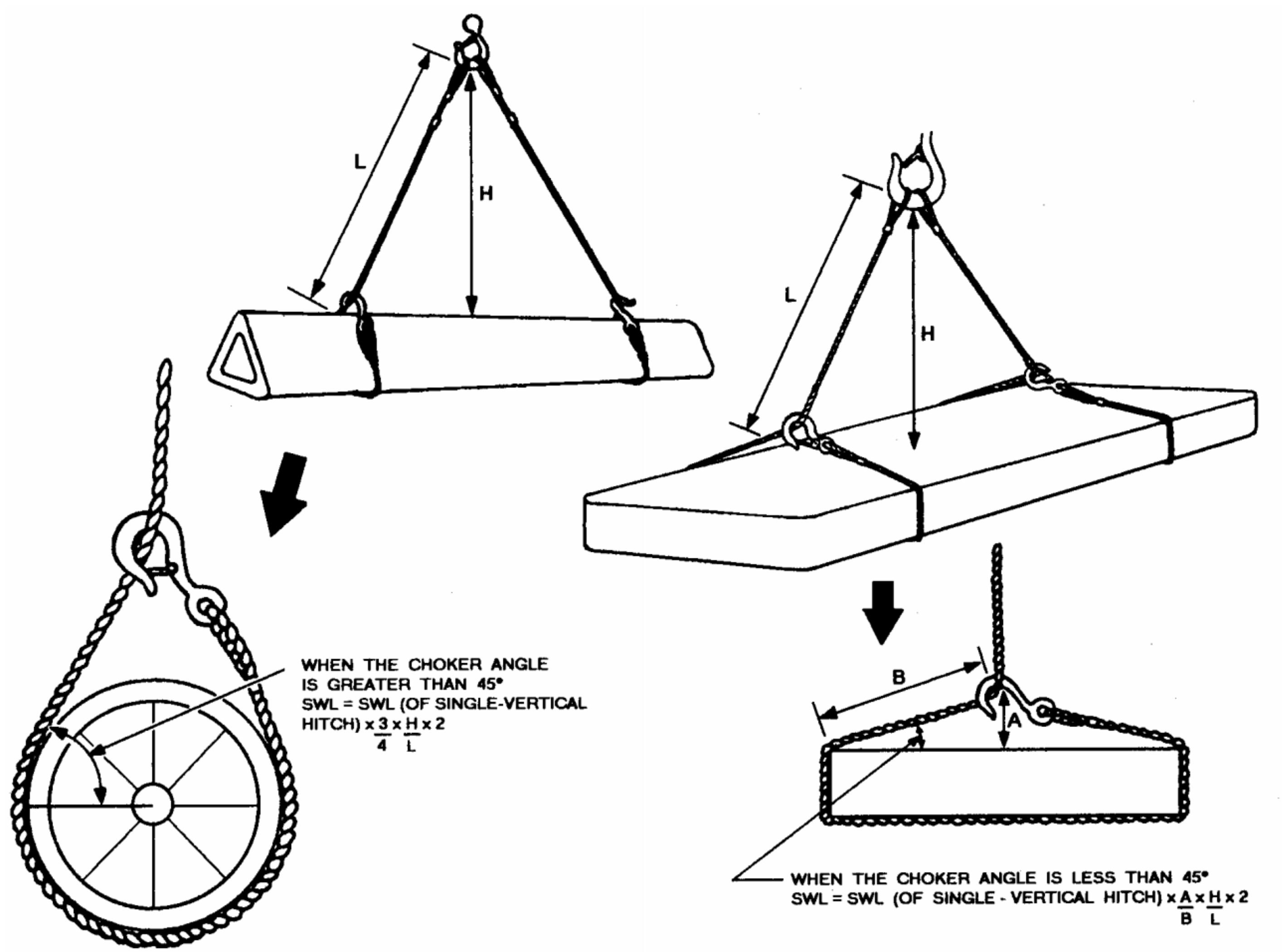


Figure 3-27.—Determination of double-choker hitch sling capacity.

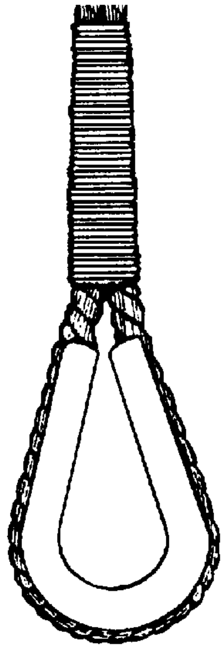


Figure 3-29.-Flemish eye and serving.

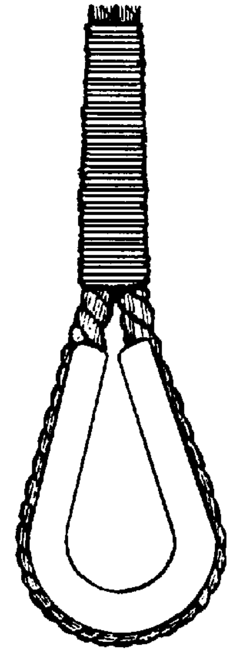


Figure 3-31.-Tucked eye and serving.

Group 1: Flemish eye and serving (fig. 3-29)
Flemish eye and pressed metal sleeve (fig. 3-30)

Group 2: Tucked eye and serving (fig. 3-31)
Tucked eye and pressed metal sleeve (fig. 3-32)

Group 3: Fold back eye and pressed metal sleeve (fig. 3-33)

The splices in group one are the best and most secure. The flemish eye with the pressed metal sleeve is recommended for all rigging and hoisting use. When properly fabricated, it develops almost 100 percent of the catalogue breaking strength. The strand ends of the spliced rope are secured against the live portion of the rope by means of a steel or aluminum sleeve set in place under pressure.

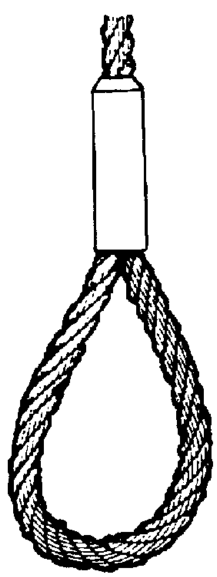


Figure 3-30.-Flemish eye and pressed metal sleeve.

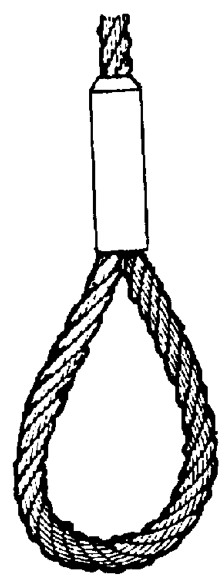


Figure 3-32.—Tucked eye and pressed metal sleeve.

Figure 3-33.—Fold back eye and pressed metal sleeve.

The tucked eye with the pressed metal sleeve is almost 100 percent efficient; however, the tucked eye and serving in group 2 can develop only 70 percent of the strength of the rope and tend to come free as the rope unwinds. As the rope untwists, the tucks in the eye begin to pop free. All eye spices in group 2 should have a least five tucks, and the complete splice should be carefully and tightly wrapped with a wire serving to cover the whole splice.

The fold back eyes and pressed metal sleeves in group 3 are fabricated by bending the rope to the eye dimension required and securing the free or dead end of the rope against the live portion of the rope by means of a steel or aluminum sleeve set in place under pressure. Improper swaging or split sleeves used with fold back eye splices (fig. 3-34) can result in complete failure without warning. It is highly recommended that these eye splices never be used for overhead hoisting operations.

An alternate method of forming a soft eye in the end of a wire rope without the use of permanent splicing is fabricating a flemish eye splice (Molley Hogan). The eye is simple to form, requiring a minimum amount of tools, and does not require use of a splicing vise. The flemish eye develops 90 percent of the breaking strength of the wire rope.

To form a flemish eye (fig. 3-35), unlay the rope strands 3 to 4 inches longer than twice the circumference of the eye size desired. The wire rope core can be cut out or laid in one section of the wire. A simple overhand knot is made, letting the strands lay together and adjusting the eye to the desired size. Bend sections of the strands through the eye so that the strands re-lay into position to form the rope. Continue until the eye is completed. Secure the bitter ends of the strand to the rope with lashing, seizing, or a wire clip to prevent unlaying of the rope. Before the sling can be put into use, it must be proof-tested and tagged.

Proof-Testing

All field-fabricated slings terminated by mechanical splices, sockets, and pressed and swaged

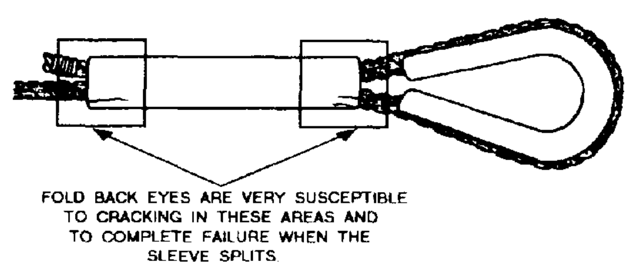


Figure 3-34.-Fold back sling failure.

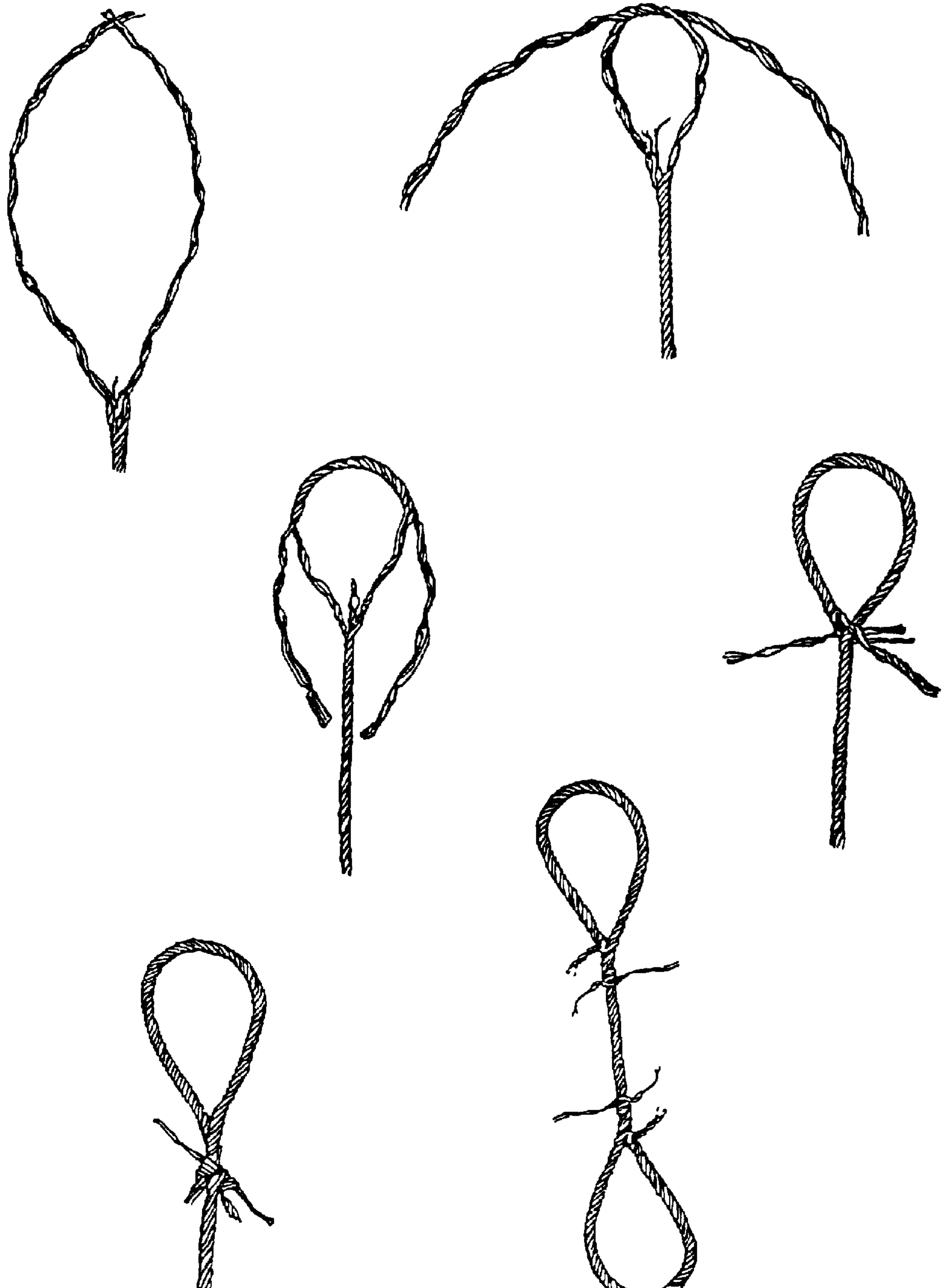


Figure 3-35.-Flemish eye development.

terminals must be proof-loaded before placing the sling in initial service.

The COMSECOND/COMTHIRDNCBINST 11200.11 series has rated capacity charts enclosed for numerous wire rope classifications. You must know the diameter, rope construction, type of core, grade, and splice on the wire rope sling before referring to the charts. The charts will give you the vertical-rated capacity for the sling. The test weight for single-leg bridle slings and endless slings is the vertical-rated capacity (V.R.C.) multiplied by two or (V.R.C. x 2 = sling test weight).

The test load for multiple-leg bridle slings must be applied to the individual legs and must be two times the vertical-rated capacity of a single-leg sling of the same size, grade, and wire rope construction. When slings and rigging are broken out of the TOA for field use, they must be proof-tested and tagged before being returned to CTR for storage.

Records

The crane crew supervisor must establish and maintain a card file system containing a record of each sling in the unit's inventory. Proof Test/Inspection Sheets (fig. 3-36) are used to document tests made on all items of weight-lifting slings, spreader bars, hooks, shackles, and so forth. These records are permanent and contain the following entries at a minimum:

1. Sling identification number (unit location and two-digit number with Alfa designation for each wire rope component)
2. Sling length
3. Cable body diameter (inches) and specifications
4. Type of splice
5. Rated capacity
6. Proof test weight
7. Date of proof test
8. Signature of proof test director

All the slings must have a permanently affixed, near the sling eye, durable identification tag containing the following information:

1. Rated capacity (in tons) (vert. SWL)
2. Rated capacity (in tons) (45-degree SWL)
3. Identification number

Spreader bars, shackles, and hooks must have the rated capacities and SWL permanently stenciled or stamped on them. OSHA identification tags can be acquired at no cost from COMTHIRDNCB DET, Port Hueneme, California, or COMSECONDNCB DET, Gulfport, Mississippi. Metal dog tags are authorized providing the required information is stamped onto the tags.

Storage

Wire rope slings and associated hardware must be stored either in coils or on reels, hung in the rigging loft, or laid on racks indoors to protect them from corrosive weather and other types of damage, such as kinking or being backed over. Slings are not to be left on the crane at the end of the workday.

Sling and Rigging Gear Kits

The NCF has slings and rigging gear in the Battalion Table of Allowance to support the rigging operations and the lifting of CESE. The kits 80104, 84003, and 84004 must remain in the custody of the supply officer in the central toolroom (CTR). The designated embarkation staff and the crane test director monitor the condition of the rigging gear. During the BEEP, the two crane crew supervisors normally have the responsibility to inventory the contents of the kits. The rigging kits must be stored undercover.

Wire Rope Sling Inspection

All wire rope slings must be visually inspected for obvious unsafe conditions before each use. A determination to remove slings from service requires experience and good judgment, especially when evaluating the remaining strength in a sling after allowing for normal wear. The safety of the sling depends primarily upon the remaining strength. Wire rope slings must be immediately removed from service if any of the following conditions are present:

1. Six randomly distributed broken wires in one rope lay or three broken wires in one strand in one lay
2. Wear or scraping on one third of the original diameter of outside individual wires

WIRE ROPE SLING PROOF TEST/INSPECTION RECORD

DATE

SLING I.D. NO.

Specification: ______________________________
Length: ______________________________
Cable body diameter: ______________________________
Type splice: ______________________________
Rated capacity (lbs): ______________________________
* Proof test weight (lbs): ______________________________
* Date of proof test: ______________ Proof test director sig: ______________
Date of inspection: ______________ Crane Supv inspector sig: ______________
Date of inspection: ______________ Crane Supv inspector sig: ______________
Date of inspection: ______________ Crane Supv inspector sig: ______________

REMARKS:

* Applies only to field fabricated slings.

WIRE ROPE SLING PROOF TEST/INSPECTION RECORD

Card ____ of ____

DATE

SLING I.D. NO.

Specification: ______________________________
Length: ______________________________
Cable body diameter: ______________________________
Type splice: ______________________________
Rated capacity (lbs): ______________________________
* Proof test weight (lbs): ______________________________
* Date of proof test: ______________ Proof test director sig: ______________
Date of inspection: ______________ Crane Supv inspector sig: ______________
Date of inspection: ______________ Crane Supv inspector sig: ______________
Date of inspection: ______________ Crane Supv inspector sig: ______________

REMARKS:

* Applies only to field fabricated slings.

Figure 3-36.-Proof Test/Inspection Sheet.

3. Kinking, crushing, bird caging, or any other damage resulting in distortion of the wire rope structure

4. Evidences of heat damage

5. End attachments that are cracked, deformed or worn

6. Hooks that have an obviously abnormal (usually 15 percent from the original specification) throat opening, measured at the narrowest point or twisted more than 10 degrees from the plane of the unbent hook

7. Corrosion of the wire rope sling or end attachments

To avoid confusion and to eliminate doubt, you must not downgrade slings to a lower rated capacity. A sling must be removed from service if it cannot safely lift the load capacity in which it is rated. Slings and hooks removed from service must be destroyed by cutting before disposal. This ensures inadvertent use by another unit. When a leg on a multiple-leg bridle sling is unsafe, you only have to destroy the damanged or unsafe leg(s). Units that have the capability may fabricate replacement legs in the field, provided the wire rope replacement is in compliance with specifications. The NCF has a hydraulic swaging and splicing kit in the Battalion Table of Allowance. The kit, 80092, contains the tools and equipment necessary to fabricate 3/8- through 5/8-inch sizes of wire rope slings. Before use, all fabricatedd slings must be proof-tested, as outlined in the COMSECOND/COMTHIRDNCBINST 11200.11 series.

Spreader bars, shackles, hooks, and so forth, must also be visually inspected before each use for obvious damage or deformation.

A visual inspection of all active slings and rigging geat must be conducted by the crane crew supervisor every 60 days. The inspections are noted on the Proof Testing/Inspection Record Cards. Any deterioration that could result in an appreciable loss of the orginal strength of a sling or component justifies it being removed immediately from service. After passing inspection, a proof test must be conducted before returning a sling to service.

Wire Rope Maintenance

Wire rope must be thoroughly claened at regular intervals. A wire brush can be used to remove most of the dirt and grit that may accumulate on the wire. Rust should also be removed when the rope is cleaned. After cleaning, you should allow the wire rope to dry before it is lubricated.

The object of cleaning wire rope is to remove all foreign material and old lubricant from the valleys between the strands and the spaces and between the outer wires to permit the lubricant to penetrate into the rope.

Wire Rope Lubrication

Periodic lubrication of wire rope is essential to prolong the life of a rope. Lubricants generally do not last through the life of a rope; therefore, this requires that the lubricant be renewed. A good grade of new oil or grease (never use engine oil) can be used for this purpose. It should be free of acids and alkalis and should be light enough to penetrate between the wires and strands of the rope and applied as uniformly as possible throughout the length of the rope. COMSECOND/COMTHIRDNCBINST recommends the use of 70:30 ratio of new oil to diesel fuel for a wire rope lubricant. Wire rope should be cleaned and lubricated before storing.

Wire Rope Safe Operating Procedures

All personnel involved with the use of wire rope slings should be thoroughly instructed and trained 10 comply with the following practices:

1. Wire rope slings must not be used with loads that exceed the rated capacities outlined in enclosure (2) of the COMSECOND/COMTHIRDNCBINST 11200.11 series. Slings not included in the enclosure must be used only according to the manufacturer's recommendation.

2. Determine the weight of a load before attempting any lift.

3. Select a sling with sufficient capacity rating.

4. Examine all hardware, equipment, tackle, and slings before using them and <u>destroy</u> all defective components.

5. Use the proper hitch.

6. Guide loads with a tag line when practical.

7. When using multiple-leg slings, select the longest sling practical to reduce the stress on the individual sling legs.

8. Attach the sling securely to the load.

9. Pad or protect any sharp corners or edges the sling may come in contact with to prevent chaffing.

10. Slings are to be kept free of kinks, loops, or twists.

11. Keep hands and fingers from between the sling and the load.

12. Start the lift slowly to avoid shock loading slings.

13. Keep slings well lubricated to prevent corrosion.

14. Do not pull slings from under a load when the load is resting on the slings; block the load up to remove slings.

15. Do not shorten a sling by knotting or using wire rope clips.

16. Do not inspect wire rope slings by passing bare hands over the rope. Broken wires, if present, may cause serious injuries. When practical, leather palm gloves should be worn when working with wire rope slings.